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HAND-BOOK

ON

NAVAL GUNNER

PREPARED BY AUTHORITY OF THE
U.S. NAVY DEPARTMENT

FOR THE USE OF THE

U. S. NAVY, U. S. MARINE CORPS, AND STATES NAVAL RESERVES

BY

CYRUS S. RADFORD,
LIEUT. U. S. MARINES

REVISED AND ENLARGED WITH THE ASSISTANCE
OF

STOKELEY MORGAN,
LIEUT. U. S. NAVY

THIRD EDITION, REVISED AND ENLARGED

NEW YORK
D. VAN NOSTRAND COMPANY
23 MURRAY AND 27 WARREN STREETS
1898

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BOSTON.

PREFACE.

FIRST EDITION.

In the preparation of this little work, the object of which is to give a practical knowledge of the mechanism, handling, and service of a ship's battery, I have arranged the subject-matter in the form of questions and answers, in order to bring out more fully the details in the simplest form possible.

C. S. R.

U. S. S. *Chicago*, December, *1891*.

SECOND EDITION.

In this edition we have worked on the lines of the original work, but have endeavored to make it more comprehensive and complete without in any way going into theory. That part subject to frequent changes has been omitted; and now that gunnery has reached more or less a fixed standard, we feel that this edition *will be of lasting* value. We are indebted to En-

sign Philip Williams, U. S. N., for the greate part of the revision of the chapter on nava B. L. R. mounts, and to Lieutenant A. P. Nil back, U. S. N., and Lieutenant Lincoln Ka mony, U. S. Marines, for valuable data.

WASHINGTON NAVY YARD, March, *1896*.

THIRD EDITION.

THE second edition being exhausted, in issu ing a new edition I have endeavored to kee abreast of the times, eliminating all obsolet matter, and introducing such new material a the progress in Ordnance justifies.

C. S. R.

U. S. S. *Texas*, March, *1898*.

AUTHORITIES CONSULTED.

Text Book of Ordnance and Gunnery. — INGERSOLL.
Accuracy and Probability of Fire. — GLENNON.
Hand-Book of Artillery. — ROBERTS.
Gunnery Catechism. — BRANDT.
The Army Officers' Examiner. — POWELL.
Ordnance and Gunnery for Non-commissioned Officer — CRANKHITE.
Gunnery Questions. — SARGENT.
Gatling, Hotchkiss, and Driggs-Schroeder Compan Pamphlets.
Gunnery Drill Book, and other department publicatio

CONTENTS.

HANDBOOK ON NAVAL GUNNERY.

CHAPTER I.

NAVAL B. L. R. GUNS.

THE GUN PROPER.

Q. What is a gun?

A. A machine intended to throw projectiles, either solid or hollow, with large charges of powder, to attain great range, accuracy, and penetration.

Q. What is a rifled gun?

A. One having a number of spiral grooves cut into the surface of its bore, for the purpose of giving the projectile a motion of rotation about a line coinciding with the direction of its flight.

Q. What are the advantages of this rotation?

A. It permits the use of an elongated projectile, and increases the range by causing the projectile to move through the air in the direction of its least resistance; and corrects the de

viation by distributing the resistance uniformly around the line of flight.

Q. What are high-powered guns?

A. Those guns with which the attainable velocity is 2,000 feet per second and upward, regardless of the caliber.

Q. How must such guns be constructed?

A. To withstand great internal pressure.

Q. What material has been found best adapted to modern gun construction, and why?

A. Steel, as it is easily fused, is malleable, is more or less weldable, accordingly as it is comparatively hard or soft. It is tough and elastic, with a high elastic and tensile strength. Its elastic limit, or elongation within that limit, is much higher than for other metals, and is capable of receiving temper.

Q. Explain the terms which go to make up the good qualities of steel.

A. Fusibility. — The quality of passing from a solid to a liquid state when subjected to heat.

Malleability. — The property of being permanently extended in all directions without rupture by pressure, as in rolling, or by impact, as in hammering.

Hardness is that quality of a metal by which it resists compression or alteration of form.

Toughness is the property of resisting fracture by bending or rolling.

Tensile strength is the stress or tension required to produce fracture.

Elasticity[1] is the property of resisting permanent deformation when subjected to a stress. However, there is a limit of strain beyond which a permanent set will be produced, which is called the elastic limit; and the limit of the corresponding stress is called the elastic strength.

Temper. — When steel is heated to a red heat, and then suddenly cooled, as by plunging in oil or water, it is said to be tempered. This operation hardens the metal, increases its tensile strength, and gives it the quality.

Q. What system is used in the construction of B. L. R. guns?

A. The built-up system.

Q. What is the built-up system?

A. It is the system in which the principal parts of the gun are separately constructed and put together in a particular manner.

Q. What two principles underlie the built-up system of gun construction?

[1] Stress denotes the forces which act to produce an *alteration of figure*, while strain denotes the alteration so *produced.*

A. First: The principle of varying elasticities, which consists in placing that material which stretches most within its elastic limit around the surface of the bore.

Second: The principle of initial tensions, which consists in giving to the exterior portion of a gun a certain initial tension, gradually decreasing towards the interior, and giving to the interior parts a certain normal state of compression by the grip of the outer cylinders and coils. Thus the interior tube, being in a state of compression, must overcome this before it can expand or undergo tension.

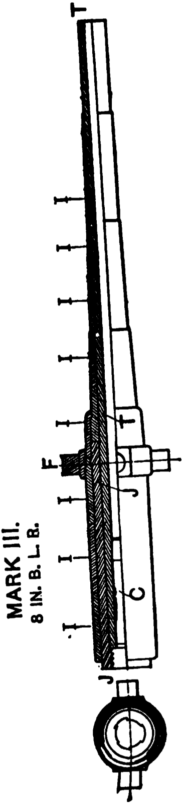
Q. Which of these principles is followed in modern naval gun construction, and why?

A. The principle of initial tension, as with a uniform grade of steel the process of manufacture is more certain and less complicated; and the system carried to an extreme, as a gun composed of an infinite number of very thin hoops properly shrunk together, represents a theoretically perfect gun.

Q. How are the tension and compression given to the parts of a gun so constructed?

A. The method of shrinkage is employed, which consists in making the inner diameter of the outer tube smaller than the outer diam-

Plate I.



To face page 5,

eter of the inner tube, and by heating the outer tube, expanding it sufficiently to fit over the inner, and, allowing it to cool, slightly extending its inner diameter, and compressing the outer diameter of the inner tube, which compression and extension are equal to the shrinkage.

Q. What are the principal parts of a gun so constructed?

A. The tube (*T*), a hollow steel forging extending the entire length of the bore; the jacket (*J*), shrunk over the tube from its breech end, extending about two-fifths of the length of the tube; jacket hoops (*I*), shrunk over the jacket; locking hoop (*L*) and chase hoops (*E*), extending to the muzzle, except in guns of 35 or 40 calibers in length, in which cases the chase hoops end at a length of about 30 calibers.

Q. How are gun-forgings made?

A. The gun steel (containing about .5 per cent of carbon) is cast from open hearth steel in solid masses or ingots under hydraulic pressure. After cooling, the ingots are reheated and forged under an hydraulic press, or by hammering. (Tubes are usually forged solid; hoops and jackets are first bored, and then forged about a mandrel.) After forging, the ingots are *annealed*, machined to rough size, *tempered in oil, and then reannealed*.

Q. What is the object of casting under pressure, and of forging?

A. To get rid of blow-holes; to prevent cracks; to force out all foreign matter, such as slag, sand, etc.; and to produce a steel of great density.

Q. What is the process of annealing, and what is its purpose?

A. The ingot is heated to a red heat, and then allowed to cool slowly. The purpose is to allow the particles of the metal to readjust themselves to a normal condition, and thus get rid of the internal tensions induced by forging and by tempering.

Q. What is tempering, and why is it done?

A. The ingot is tempered by heating to a red heat, then cooled more or less slowly, according to the hardness required, by plunging into oil, water, or a mixture of the two. The effect is to increase the toughness of the metal, to add to its tensile strength, and to make it harder and more elastic.

Q. Give a general description of the manufacture of the new B. L. R. guns.

A. The complete set of forgings for a gun having been accepted, the shrinkages are calcu*lated, using the lowest* elastic limit shown b

any specimen from each forging, as the basis of the computations. The jacket-forging is bored to the required diameter, the screw-box being only roughed out, and is then carefully star-gauged. While this is being done, the hoops are also finished, bored, and faced, and then star-gauged. The tube is first bored out nearly to finished size, and is then turned to a diameter at each point exceeding the interior diameter of the jacket at the corresponding point by the assigned shrinkage. The tube is then placed vertically in the shrinking-pit; and the jacket, having been expanded by heat, is lowered down over it, and then allowed to cool. The assembled tube and jacket are next placed in a lathe, and the tube is turned to the proper diameters for the chase hoops, which are put on successively, each with its assigned shrinkage; after which the jacket is turned for the jacket hoops, and they are put on in the same manner.

Q. Give the nomenclature of the exterior of a B: L. R. gun.

A. Trunnions, two solid cylindrical arms projecting from the sides of the gun for supporting it on its carriage; not fitted to 10, 12, and 13-inch guns, nor on rapid-fire guns.

Rimbases are the shoulders forming the junction between the trunnions and the piece.

Body of the piece is that part in rear of the trunnions.

Chase, that part in front of the trunnions.

Muzzle face, breech face, the terminating planes at the muzzle and breech respectively, and perpendicular to the axis of the bore.

Q. Give the nomenclature of the interior of a B. L. R. gun.

A. The *bore,* extending the entire length of tube.

Grooves, spiral cuts in the surface of the bore by which the projectile is given a motion of rotation.

Lands, portions of the bore between the grooves.

Compression slope, the slope from the chamber to the rifling, and receives the compression band of the projectile.

Front cylinder, that part of the bore in rear of the compression slope, and is known as the centering cylinder for centering the projectile; not in the latest guns.

Chamber, including slope and cylinder; forms the rear part of the bore, and holds the powder charge.

Gas check seat, a short length in rear of cylinder of chamber, for receiving mushroom head and gas check.

Screw-box, with blanks and threads, into which the breech plug screws.

Q. What is the order of work after the parts are assembled?

A. The gun is finished, bored, the chamber is bored out, the compression and gas check slopes are reamed out, the screw-box is threaded, and the exterior is finished, turned.

Q. When are the trunnion and elevating bands fitted?

A. After the gun is smooth-finished, the trunnion band is screwed on cold, and the elevating band is then lightly shrunk and keyed on.

Q. How is the trunnion band placed?

A. So that there is no preponderance; that is, the gun pivots at this point.

Q. What yet remains to be done before the gun is ready for issue to the service?

A. Lastly, the gun is rifled, the screw-box blanks are planed out, the breech mechanism is fitted, the gun is sighted, and is tested by proof-firing at the Proving Grounds.

Q. In what does the proof-firing consist?

A. In firing seven rounds with full charges and service projectiles under the circumstances of the service, so far as possible, the rounds being fired rapidly in succession.

Q. What determines the length of the bore of a gun?

A. The length of bore greatly affects the velocity of the projectile, and with slow-burning powders and service projectiles the longer the bore the greater the velocity.

Q. When is a gun chambered, and what is the object?

A. When the seat of the charge is not of the same diameter as the bore. The object is to permit the use of larger powder charges, thereby gaining increased velocity.

Q. What strains are put upon a gun by the explosion of the charge?

A. A transverse strain, tending to enlarge the gun and rupture it; and a longitudinal strain, tending to stretch it out in the direction of its length.

Q. What part of the gun bears the main transverse or enlarging strain?

A. The tube.

Q. What part takes the longitudinal or lengthening strain?

A. The jacket.

Q. How is the exterior form of a gun determined?

A. By the variable pressures it is required to stand at different points of its length; it is greatest at the breech, and decreases as the muzzle is approached.

Q. How does the use of rifling affect the strains upon a gun?

A. It very much increases the strains by the use of larger powder charges, and by the small loss by leakage around the projectile.

Q. How is the rifling done?

A. The gun is rigidly secured, while the rifling-bar — a heavy cylindrical steel bar — has a motion of translation and rotation. On the surface of rifling-bar is cut a groove corresponding with the twist of rifling required; and as the bar travels down the bore, a rest stud working in the groove transmits the proper twist to the cutters of the rifling-head. There are three or four cutters to each head, depending whether the whole number of grooves is a multiple of three or four; and it requires from ten to fourteen cuts to finish each set of three or four grooves.

Q. What determines the form of the spiral grooves?

A. The *angle* which the tangent line at any *point makes* with the corresponding element of

the bore. If this angle be the same at every point, the groove is said to be *uniform.* If it increases from the breech to the muzzle, the groove is called *increasing;* if the reverse, *decreasing.*

Q. What system of rifling is used?

A. The poly-groove system.

Q. What is understood by the term TWIST?

A. It is employed by gunmakers to express the inclination of a groove at any point, and is measured by the tangent of the angle made by the groove with the axis of the bore.

Q. To what is this tangent equal?

A. To the quotient obtained by dividing the circumference of the bore by the length of one revolution of the spiral, estimated in the direction of the axis.

Q. Is the twist of the rifling regular?

A. No; it increases from the beginning to a short distance from the muzzle, the remainder being regular.

Q. When the grooves are very wide, and lands very narrow, what is the rifling called?

A. Ribbed rifling.

Q. Give an example.

A. The 3-inch B. L. H. and 47-mm. revolving cannon.

Q. How many grooves in the 6-inch B. L. R.?

A. Twenty-four.

Q. What is the rule for the number of grooves?

A. Four times the caliber in inches for the larger calibers; the 4-inch and 5-inch have each thirty grooves.

Q. What is the depth of the grooves in B. L. R. guns?

A. .05 of an inch, except in 4-inch, when it is .025 of an inch.

Q. Are the grooves the same width all along?

A. No; they decrease as the muzzle is approached, which prevents the escape of gas past the projectile.

Q. What is the caliber of a rifled gun?

A. It is the diameter of a cylinder which touches the highest points of all the lands.

Q. Is it the same with ribbed rifling?

A. No; with ribbed rifling it is the diameter of a cylinder which touches the lowest points of all the grooves.

Q. How are the new guns rifled?

A. With a right-handed twist, looking outboard from breech.

Q. What is drift?

A. It is the tendency of the projectile to depart gradually from the plane of fire, in a direction the same as that of the twist.

Q. What is meant by a 35-caliber 6-inch B. L. R.?

A. It is a 6-inch gun 35 calibers in length.

Q. The number of calibers being known, how do you find the length of the bore?

A. Multiply the number of calibers by the caliber in inches.

Q. What is the length of the bore of a gun?

A. It is the distance from the muzzle to the face of the breech plug, including rifle part of bore, compression slope, and powder chamber.

Q. In what part of the gun does the breech plug fit?

A. In the jacket.

BREECH MECHANISM.

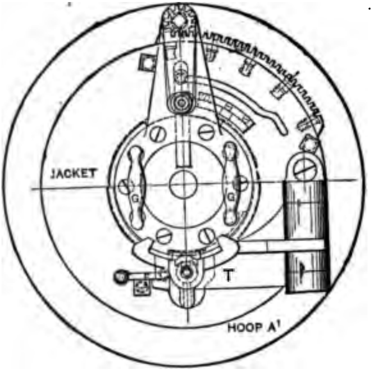
Q. What is the first requirement that a breech mechanism should fulfill?

A. It should stop completely all escape of gas to the rear.

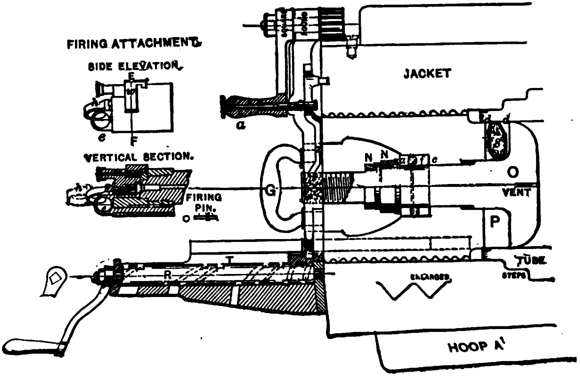
Plate II.

BREECH MECHANISM

FOR 8 IN. B. L. R.



REAR VIEW.



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Q. What other considerations are important?

A. First: That it should not weaken the gun.

Second: That it can be easily repaired.

Third: That it should be easy to work.

Fourth: That the sealing or "obturation" against the escape of gas should be automatic; and the greater the pressure the more complete and secure the sealing.

Q. What system of breech mechanism is used in the B. L. R. guns?

A. The interrupted screw system, combined with the De Bange gas check.

Q. What is the interrupted screw system?

A. The breech block has a thread cut on its outer surface, the circumference being divided into equal parts, and from one-half of these the threads are cut away longitudinally.

Q. How does the block fit in the breech?

A. The screw-box in jacket is similarly divided.

Q. Of what does the De Bange gas check consist?

A. Of a mushroom head and shank (*o*), front and rear gas-check disks, obturator pad (*P*), frictionless washer (*f*), and shank nuts (N).

Q. How is it fitted?

A. The shank, with obturator pad between the mushroom head and the front face of the breech block, passes through the breech block, and is set up by two nuts, the inner of which takes against the frictionless washer.

Q. What is the obturator pad?

A. It consists of two steel disks (*d*), slightly hollowed so as to receive between them a pad (*s*) of asbestus and tallow inclosed in a canvas covering, and pressed into shape by hydraulic pressure.

Q. How is the canvas put on the pad?

A. Sewed on by hand.

Q. What is the object of the frictionless washer?

A. It relieves the friction, and prevents the pad from turning when the plug is turned for opening.

Q. How is the proper pressure given to the pad?

A. By setting up the shank nuts.

Q. In setting up the shank nuts, what precaution should be taken?

A. Not to set up too much, as the plug may stick after firing.

Q. Can a pad be used after it is once broken?

A. Yes; provided the checking circumference is intact.

Q. How may a pad be repaired that has broken across its circumference?

A. By inserting a patch dovetailed in and neatly sewed.

Q. What is the object of the dovetailing?

A. To prevent running a seam directly across.

Q. What ordinarily should be the life of a pad?

A. About two hundred rounds.

Q. What is the vent?

A. The aperture through which flame is communicated to the charge.

Q. What is the usual diameter of the vent?

A. Two-tenths of an inch.

Q. Where is the vent for B. L. R. guns?

A. It is bored through the shank of the mushroom.

Q. Why is it placed there?

A. This is the best position to insure early ignition of the powder.

Q. How does this insure early ignition?

A. Because the holes in the powder grains are *coincident,* and their axes parallel to the *axis of the* vent.

Q. Is the system of opening and closing the breech the same for all calibers of guns?

A. No; it not only differs with the different calibers, but in some instances with the different marks of the same caliber.

Q. Describe the system for the 8-inch Marks I. and II. guns.

A. The plug is rotated by a crank (*a*), which turns a pinion (*2*) attached to the end of the plug lever (*3*), and engaging a circular rack (*4*) bolted to the breech of the gun. The breech is then opened by a roller (*R*) which has a double groove of increasing pitch engaging two studs on the button of the saddle (*z*), which itself engages the bottom of the plug, so that when the roller crank is turned the plug is withdrawn, first slowly and with great power, and then rapidly landing it on the plug tray (*T*), which, turning on its hinge, clears the breech for loading.

Q. How does the new 6-inch B. L. R. mechanism differ from this?

A. It is not provided with withdrawing roller, the plug being withdrawn by a handle on the rear face of breech plug.

Q. What prevents the plug tray from swinging open when the breech is closed?

BREECH-MECHANISM.
12 INCH BREECH LOADING RIFLE.
MARK 4.

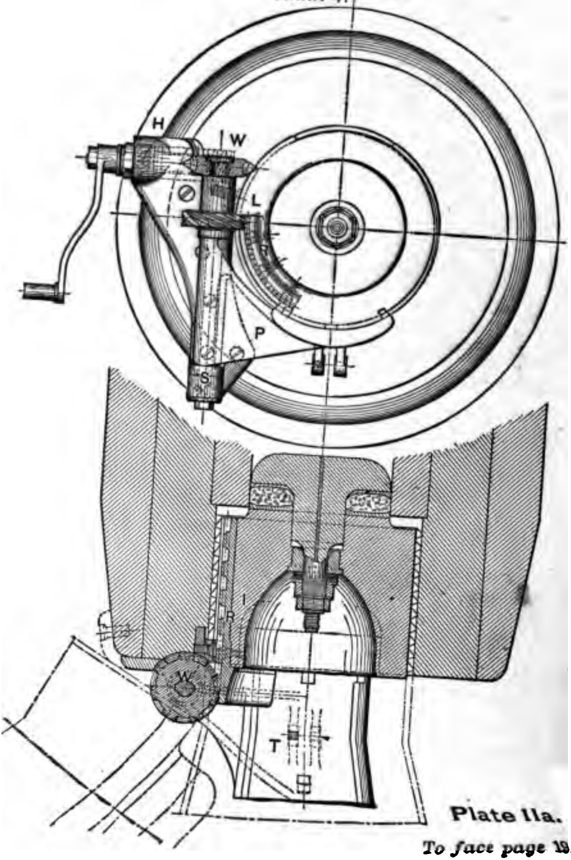

Plate IIa.

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A. It is held in place by a tray latch (*r*) underneath. In the new guns this latch, besides being released automatically when the plug is on the tray, holds it in place.

Q. When swung open, what prevents the tray from closing?

A. A back latch holds it in place.

Q. Are the earlier Marks of 6-inch and Mark I. 5-inch guns provided with the rotating breech gear?

A. No; they are provided with a folding lever eccentric about its pivot, which when turned down locks the mechanism, but when turned up, and forced over, revolves the breech plug until unlocked, the plug being withdrawn by hand.

Q. Describe the breech mechanism that is now being fitted to the latest designs of 8, 10, 12, and 13 inch guns.

A. A vertical shaft (*s*), acting as a hinge pin for the plug tray (*P*), carries on its upper end a worm wheel (*w*), and on its central part a spiral pinion (*L*). A crank, through a horizontal crank shaft (*H*) and worm-gearing, turns the shaft (*S*), and also the spiral pinion (L), which gears into a spiral rack (*R*) on the exterior of the plug. By the peculiar design of this rack, one part

which is countersunk lengthwise in the plug, acts as a withdrawing rack, and another part, which extends to the rear and circumferentially around the plug, acts as a rotating-rack. The plug being locked, upon turning the crank the first action is to revolve the plug by means of the spiral pinion engaging the rotating-rack, and then to withdraw it by the pinion taking in the withdrawing rack. When the plug is completely withdrawn, an automatic tray latch (*T*) releases the plug tray from the gun, at the same time locking the plug on the tray, and the continued turning of the crank swings the tray to the left until the breech plug is clear.

Q. In closing the breech, what limits the revolution of the plug?

A. A locking-stop ( ) screwed in the face of the breech; and two rotation stops screwed to the hinge plate act as guides to the plug when the pinion (*L*) is not in gear with the rack slot.

Q. How are B. L. R. guns fired?

A. By a spring lock screwed to the shank of the mushroom.

Q. Of what does the spring lock consist?

A. Of a receiver carrying a hammer (*h*), extractor (*e*), and wedge (*w*) containing the firing-pin (*p*).

Q. What primers are used?

A. Electric and percussion primers.

Q. How is the primer placed in the vent?

A. By throwing back the wedge and inserting with the hand.

Q. How is it fired?

A. By pulling the lock string, which frees the hammer, and allows it to strike the firing-pin; or by electricity.

Q. With the electric primer, is the same wedge used as with the percussion primer?

A. No; there is a separate wedge with a curved slot for wire in place of the firing-pin.

Q. Is the firing-lock kept on the gun?

A. No; it is kept in a leather case, and is only screwed on when needed.

Q. What prevents the projectile from bruising the thread of screw-box in loading?

A. A loading-tray is fitted in the breech.

Q. How is the loading-tray made?

A. It is made to fit the breech, the bearing-surface being of wood.

Q. How is it held in place in the breech?

A. By a shoulder, or thumb catch, on its *bottom.*

Q. What are some of the advantages of breech-loading guns?

A. First: The powder chamber can be increased in diameter, thereby allowing a larger powder charge.

Second: Rapidity of fire, which increases the probability of hitting.

Third: Better protection for the crew.

Fourth: Saves time in loading.

Fifth: More accurate, as the projectile is better centered.

Sixth: Greater length of bore, and hence increased muzzle velocity.

Seventh: Facility of examining the bore.

Eighth: The grooves are shallower.

CHAPTER II.

RAPID-FIRING GUNS.

GENERAL.

Q. What is a rapid-firing gun?

A. It is a single-barrel mounted gun firing fixed ammunition.

Q. How are these guns usually designated?

A. By the caliber as low as the 4-inch, and, for lighter guns, by the weight of the projectile thrown.

Q. In what part of a ship's armament are they classed?

A. The heavier calibers, 4-inch and above, form a portion of the main battery; the lighter guns, together with machine guns, the secondary battery.

Q. For what are they used?

A. To destroy unarmored ships, unarmored ends of ironclads; to disable unprotected guns and gun machinery; against torpedo boats, gun

shields, tops, and gunports. The heavier calibers can also be used against light armor with good effect.

Q. What is their value defensively?

A. By their continuous and accurate fire they check and prevent attacks by torpedo boats.

Q. What are some of the distinctive features of a rapid-fire gun?

A. Quick loading and quick training, giving great rapidity of fire; accuracy, and a small number of men for the service of the gun.

Q. What rapid-fire guns are used in the service?

A. 4, 5, and 6-inch; 1-pounders, 3-pounders, and 6-pounders.

Q. What types of 4, 5, and 6 inch R. F. guns are used?

A. The Dashiell and Fletcher.

Q. In what do they differ?

A. In the breech mechanism.

Q. Of what does the Dashiell mechanism consist?

A. Of a breech plug (1), combined collar and tray (3), operating-mechanism, extractor, and firing-mechanism.

To face page 25.

Plate III.

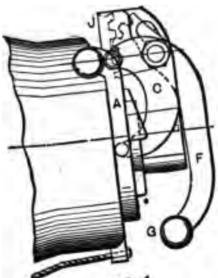


FIG. 1.
TOP VIEW,
BREECH CLOSED.

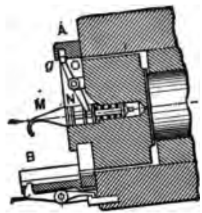


FIG. 2.
VERTICAL SECTION,
BREECH CLOSED.

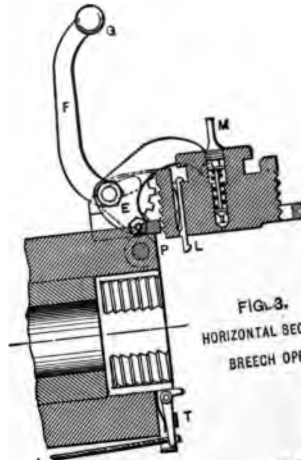


FIG. 3.
HORIZONTAL SECTION,
BREECH OPEN.

DASHIELL BREECH MECHANISM FOR R.F. GUNS OF LARGE CALIBER.

Q. How is the breech plug fitted?

A. It is on the slotted-screw system, having four blanks and four grooves.

Q. What is the object of the collar and tray?

A. It is hinged to the breech of the gun, and carries the operating-mechanism.

Q. What are the principal parts of the operating-mechanism?

A. Translating-arm (*C*), hand lever (*F*), and rotating-rack (*J*).

Q. What is the translating-arm?

A. It is a curved lever, one end of which pivots on the right side of the tray, and the other end, by means of a vertical toe, engages an undercut groove in the plug.

Q. What is the hand lever?

A. It is a horizontal lever for opening and closing the breech; has a handle or hand-grasp on its free end, and a cogged arc at its other end. At the center of the cogged arc it is pivoted to an elbow of the translating-arm, and at this point the tray has a curved slot to allow the fulcrum pin to move with the pivot of the translating-arm as a center, during longitudinal movement of the plug.

Q. What is the rotating-rack?

A. It is a horizontal bar, sliding in grooves in front part of tray, and is cogged to receive cogged arc of hand lever, and to engage cogs on lower part of breech plug.

Q. How is the breech opened?

A. A pull on the hand lever revolves the cogged arc, which gearing, with rotating-rack, forces it to the left, engaging the plug, which is rotated until unlocked. The movement of the rack is now checked by rack stud, and a further pull on the lever causes the lever and translating-arm to swing about their common center, withdrawing the plug on the tray, tripping the tray latch, and swinging the mechanism clear for loading.

Q. What is the extractor?

A. The extractor (*L*) is a stout bar of steel passing through a longitudinal slot in breech plug, and held down by a flat spring. When the plug is closed, the nib of extractor rides over the rim of cartridge case, and is firmly held in place by the spring. It is given a small amount of longitudinal play, so that when the plug is withdrawn, the extractor is left behind, until this last motion is taken up, when it acts as a hammer, and with a blow starts the cartridge case, and draws it to the rear.

Q. Of what does the firing-mechanism consist?

A. It consists of a straight firing-pin (*M*), actuated by a spiral spring, and held in place by a spool-shaped sleeve (*N*), into the collar of which one end of the cocking-lever (*O*) fits.

Q. How does it act?

A. As the plug is unlocked, the lever moves the sleeve to the rear, cocking the pin, which is held to the rear on the toe of the sear bar. Motion in the opposite direction in locking compresses the spring, and leaves the pin cocked. When locked, the outer hook of the sear engages the trigger (*T*).

Q. What is the trigger?

A. It is a steel bar pivoted to the face of the breech, the inner end engaging a hook of the sear, the outer end, to which a laniard is attached, being outside the body of the gun, and in a trigger box on the left side. When the laniard is pulled, the firing-pin is released from the sear, and flies forward under the action of the spring, exploding the primers in the base of cartridge case.

Q. What is the safety cap?

A. A cap over the rear end of the firing-pin, screwing into the breech plug, to prevent the *firing-pin being* blown to the rear in case of *defective* primers.

Q. What modifications of the firing-mechanism are necessary for electric primers?

A. The percussion firing-mechanism is removed, and the electric firing-pin inserted.

Q. Of what does it consist?

A. Of a steel case screwing into the breech plug with an interrupted screw thread. Through the center of the case is an insulated pin, held in place against the primer when breech is closed by a spiral spring. Into the outer end of the case screws a transverse arm, also carrying an insulated spring, one end of which is held firmly against the axial pin, the other against one terminal of an attachment lug on the side of the gun.

Q. What is the attachment lug?

A. It is a steel lug on the side of the gun, taking the place of the percussion trigger-box. On it are two terminals; one for the battery leading-wire, and the other against which the transverse arm of firing-pin presses when breech is closed and locked. Between these terminals is a socket to take the double pole terminal of the firing-key.

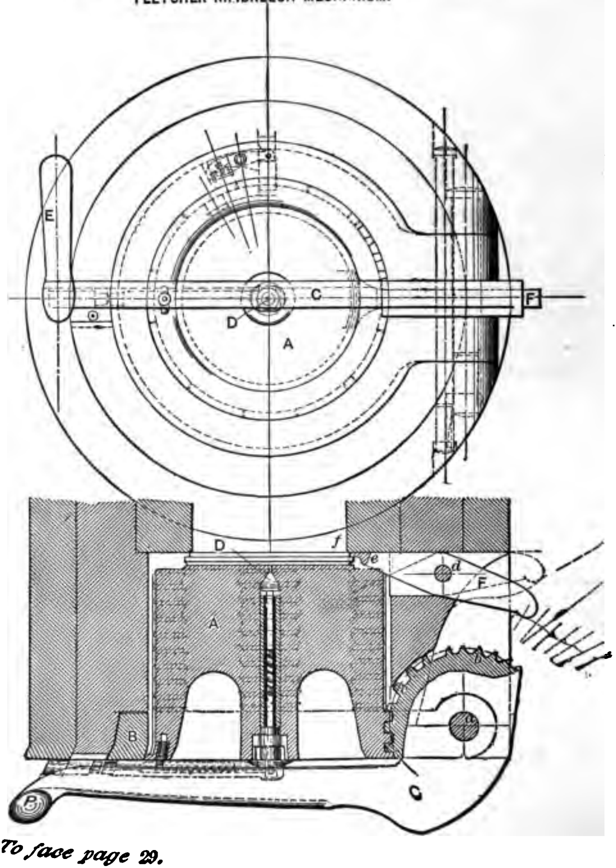
Q. What is the firing-key?

A. It consists of a split wooden handle, with *two brass terminals*, held apart by a spring. It

Plate IV.

6 IN. BREECH LOADING RIFLE.

FLETCHER R.F. BREECH MECHANISM.



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is wired with a duplex flexible conductor of any length, ending in a double pole terminal.

Q. What is the action of the electric firing-mechanism?

A. When breech is closed, the axial pin is held firmly against the head of primer in cartridge case. As the plug is turned to locked position, the transverse arm revolves, and comes up against one terminal on the attachment lug. One pole of firing-battery is in contact with the gun mount, and the return circuit is through primer case, gun, and mount. When firing-key is pressed, the circuit is completed, and primer exploded.

Q. What are the principal parts of the Fletcher breech mechanism?

A. The breech plug (*A*), collar (*B*), operating-mechanism, firing-pin, and extractor.

Q. What are the essential features of the plug?

A. It is on the interrupted screw system with four (sometimes six) threads and blanks, and fitted with a circular 45° toothed arc to engage the teeth of the rotating-pinion of the operating-mechanism.

Q. What is the collar?

A. It is a steel band pivoted to the right side of the gun, and bearing the breech plug when it

is withdrawn and swung clear of the gun. When plug is entered into screw-box, the collar sets into a recess in the breech face, and is locked in that position by a locking-stud, one end of which enters a recess in the gun, the other end into a longitudinal slot on the breech plug.

Q. Of what does the operating-mechanism consist?

A. Of a lever (*C*) pivoted on same bolt (*a*), and between the two lugs of collar-bearings. It carries at the free end a grasp handle (*E*), and at the other a circular arc, one portion of which, the rotating-pinion (*c*), is toothed to engage the rotating-rack on the breech plug; the other, the translating-pinion (*b*), to engage the threads on the plug.

Q. What is the action of the mechanism?

A. When the breech is closed and locked, the lever lies across and close against the breach face. As it is pulled sharply to the rear, revolving about its pivot, the rotating-pinion engages the rack, and the plug is revolved, the locking-stud in collar traveling in a radial slot in plug. When threads and blanks are clear for withdrawing, the translating-pinion engages the threads of plug, and carries it to the rear, the collar stud traveling in a longitudinal slot on plug. When the plug is clear of the screw-

box a spring forces the collar stud into a recess in plug, securely locking it to the collar, and at the same time releasing the collar from the gun. Further motion of the lever swings the collar and plug around clear for loading. The action is the reverse in closing, the collar being locked to the gun by the locking-stud as it rises out of the locking-recess in plug, and begins to travel along the longitudinal slot.

Q. Of what does the firing-mechanism consist?

A. It consists (*D*) of a steel case carrying an insulated firing-pin passing through the center of the plug, and securely locked by a bayonet joint. The case has also a transverse arm, also containing an insulated firing-pin, lying across and secured to the rear face of plug. When the breech is closed and locked, the point of the axial firing-pin is held firmly against the primer head by a spiral spring, while the transverse firing-pin is forced against one terminal of a lug on the side of the gun.

Q. What is the form of extractor used?

A. It consists of a lever (*F*) pivoted to and working in a recess in the gun body (*d*), in front of the collar bolt, and in same plane as the hand lever. One end of the extractor lever lies in the screw-box, with nib (*e*) under the rim of

cartridge case (*b*); the other end projects out from the gun.

Q. What is its action?

A. As the plug is swung clear of the gun, the back of the lever, which has a cam-shaped surface, strikes the projecting end of extractor lever with a blow, moving the cartridge case to the rear, at first very slowly, but with increasing rapidity.

Q. What are the advantages of this system of breech mechanism?

A. Small number of parts, simplicity of action, compactness, and delayed and certain extraction of cartridge cases.

SIGHTS.

CHAPTER III.

SIGHTS.

Q. How are B. L. R. guns sighted?

A. By two sights, — front and rear sights.

Q. What is the front sight?

A. It is a tapering piece of steel secured to a sight mass on either side of the trunnion band; or in R. F. guns to the port end of the slide bracket.

Q. Why is not this sight placed on the center of the gun?

A. Because in great elevations the muzzle of the gun would interrupt the line of sight.

Q. What is the rear sight?

A. It is a square or rectangular steel bar working in a sight-bar box secured to the rear hoop of the gun, or to the rear end of the slide bracket; and usually fitted with a traversing-head.

Q. What is the traversing-head usually called?

A. The sliding-leaf.

Q. What is the sliding-leaf used for?

A. To correct for the force of the wind, the movement of the ship or that of the target.

Q. How is the sliding-leaf graduated?

A. In knots and fractions of a knot.

Q. How are the divisions on the sliding-leaf determined?

A. For a mean range of 2,400 yards, and a mean velocity over this range of 1,800 feet per second.

Q. How is the correction ascertained?

A. By taking one-fifth the velocity of the wind in knots per hour and adding or subtracting this from the combined speed of ship and target. Thus, Gun moving 10 knots to left; target 6 knots to right; combined speed $10 + 6 = 16$ to left. Wind 15 knots to left. $15 \div 5 = 3$ to left. $16 + 3 = 19$. Move the sliding head to mark 19 knots left.

Q. What is the usual shape of the rear sight notch?

A. Two sharp points lead up an inch or more, *and are bent* at right angles toward each other. *nearly meeting.*

Q. What is such a sight called?

A. An open sight.

Q. What is the advantage of an open sight?

A. The target may be seen above and below the line of sight.

Q. What other form of rear sight notch is used?

A. The peep sight.

Q. What is the shape of the peep sight?

A. A circular opening, about one-half inch in diameter, with a small notch at lowest point.

Q. What are the advantages of a peep sight?

A. It allows the gun captain to place his eye nearer the sight, giving greater accuracy, and permitting him to work the elevating-gear of R. F. gun mounts.

Q. How is the rear sight raised and lowered?

A. By a rack cut in the bar, a worm wheel working in the rack, and driven by bevel gear and a thumbscrew; or by hand, and clamped in position by a clamp screw.

Q. How is the sight bar graduated?

A. The rear and right sides are graduated to each hundred yards for a certain charge; the rear side for full charge, the right side for

reduced charge. On R. F. gun sights the graduations for full charge alone are given.

Q. What besides these graduations are marked on the bar?

A. The elevation in degrees on the left side, and the time of flight corresponding to the different ranges on the rear.

Q. Is the rear sight set vertically?

A. No; it is placed at a permanent angle to allow for the drift.

Q. Is the line of sight parallel to the axis of the bore when gun is level?

A. No; the rear sight has a greater offset than the front one to allow for drift at point-blank range.

Q. What is the amount of permanent angle necessary with guns of our service?

A. 2° 45′ to the left.

Q. What is the sight radius?

A. The distance from the front to rear sight.

Q. What is the advantage of a long-sight radius?

A. It adds to the accuracy of sighting, and increases the distance between the divisions of graduations of the rear sight bar.

Q. How are the graduations of the rear sight bar determined?

A. By making the angle subtended at the front sight by the elevated portion of the rear sight equal to the angle of elevation of the gun necessary to give the required range, correction being made for jump.

Q. What is the jump?

A. The error in elevation due to the sudden jump of the gun at the instant of discharge.

Q. How is the angle of elevation necessary to give a given range determined?

A. By experimental firing at the Proving Ground.

Q. What is a range table?

A. A tabulated form, giving the range in yards of each caliber of gun with service charges and projectiles, the angle of elevation necessary to give the range and the time of flight over the range.

Q. How is the data for the range table obtained?

A. By experimental firing.

Q. What other form of sights have lately been adopted in the service?

A. Telescope sights.

Q. How are telescope sights arranged?

A. A refracting telescope of wide field and small magnifying-power is mounted in trunnions on the rear end of the slide bracket, with its axis nearly parallel to the axis of the gun.

Q. How is the telescope sight used?

A. The telescope is given the proper elevation, and the gun captain, with his eye at the eyepiece, then elevates or depresses the gun until the target is seen in the rectangle formed by a double set of cross wires in the telescope.

Q. How is the telescope elevated?

A. By a drum at the rear, with a thumbscrew, which works a screw of constant pitch, and moves the axis of telescope up and down in the vertical plane.

Q. How is it graduated?

A. To each hundred yards of range marked around the outside surface of the drum, the graduations being made to correspond with the angular elevations of the line of sight necessary to give the range required.

Q. How is the range indicated?

A. By a pointer fixed to the telescope stand, and moving over the several graduations as the drum is turned.

Q. How is drift in elevation compensated for?

A. By setting the telescope in its trunnions at a permanent angle.

Q. How is drift at point-blank range compensated for?

A. By setting the axis of telescope at a small angle to the axis of the bore when telescope is level.

Q. How are telescope sights arranged in turret mounts?

A. By mounting the telescope on a small platform in the sighting-hood, and automatically reproducing every movement of the gun in elevation and depression by a coincident movement of the axis of the telescope.

Q. How is this done?

A. By mechanical or hydraulic gearing from the trunnions of the gun to the telescope mounting.

CHAPTER IV.

MODERN NAVAL GUN MOUNTS.

GENERAL FEATURES.

Q. How are the new naval guns mounted?

A. On hydraulic recoil and non-recoil mounts.

Q. What is an hydraulic recoil mount?

A. A mount in which the force of recoil is opposed and controlled by the action of a piston passing through a cylinder filled with liquid.

Q. What are the general features of this class of recoil mounts?

A. 1. A recoil cylinder of bronze or steel, filled with a non-freezing mixture of glycerine and water, having grooves of varying width cut in its inner surface along the direction of its length.

2. A piston of bronze or steel fitting neatly into the cylinder.

3. A piston rod of steel, screwed into th' piston at one end, and passing out of the cyli

der through a stuffing-box, the outer end of the rod secured either to gun or mount.

Q. Describe the action of this system of controlling recoil.

A. The piston, actuated by the movement of the gun to the rear, when fired passes from one end of the cylinder to the other, thus forcing the liquid through the grooves from one side of the piston to the other.

Q. How is the pressure in the cylinder during recoil made uniform?

A. The width of the groove is greater opposite the piston at the beginning of recoil than it is at the end.

Q. How many kinds of hydraulic recoil mounts are there in use in the navy?

A. Three, — gravity-return, rapid-fire, and turret mounts.

GRAVITY-RETURN MOUNT.

Q. What is a gravity-return mount?

A. It is a mount on which the gun returns to battery, after recoil, by its own weight.

Q. How are these mounts made?

A. In two parts, — the carriage and the slide.

Q. To which part is the gun secured?

A. To the carriage, which moves in and out on the slide.

Q. How is the slide arranged to enable the gun to run out by its weight?

A. The bearing-surface of the slide is inclined downward.

Q. What guns have gravity-return mounts?

A. The 6-inch and 8-inch B. L. R.

Q. How many kinds of gravity-return mounts are there in use in the navy?

A. Four of 6-inch and four of 8-inch.

Q. What are the four kinds of 6-inch gravity-return mounts.

A. The shifting, the broadside, the central pivot Mark III., and the central pivot mount Mark IV.

THE SHIFTING MOUNT.

Q. What are the principal parts of the shifting mount?

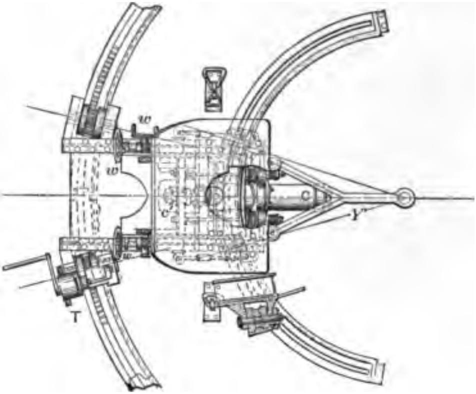
A. The slide and the top carriage.

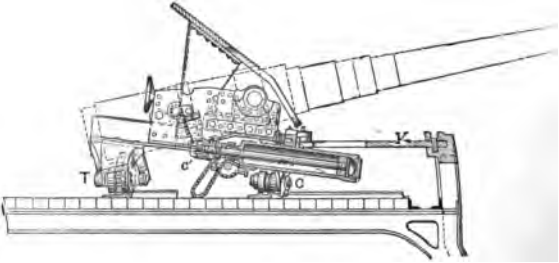
Q. Describe the slide.

A. The slide consists of two parallel I. girders inclined downward to the front at an angle

Plate V.

6 IN. BROADSIDE CARRIAGE, PORT PIVOTED.





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of 10°, and rigidly connected by crosspieces, called transoms. It is supported at its four corners by coned rollers, called trucks, which work on semicircular tracks, called deck-circles.

Q. What holds the slide in place?

A. Holding-down clips, which fit under flanges on the deck circles, secure it to the semicircular tracks, and a Y-shaped yoke pivots it to the gun-port.

Q. Describe the top carriage.

A. The top carriage consists of two side brackets and transoms. The brackets contain the trunnion seats. The top carriage moves along the upper edge of the I. girders of the slide, and the recoil is taken by a recoil cylinder secured to the slide, the free end of the piston rod being secured to the carriage transom.

Q. How is the gun trained?

A. By tackles, or by the training-crank, which works a system of cog-gearing secured at the end of the rear transom, and working into a rack on the rear training-circle.

Q. How is the gun elevated?

A. By means of hand elevator wheels connected by cogged gearing with an arc secured to the gun.

Q. Why is this called a shifting mount?

A. Because it is fitted with extra trucks, called shifting-trucks, which are used when the gun is shifted from one gun port to another.

6-INCH BROADSIDE CARRIAGE.

Q. How does the 6-inch broadside carriage differ from the 6-inch shifting-carriage?

A. 1. There are no shifting-trucks.

2. The front trucks are scored to receive the lip of the front training-circles.

3. The positions of the holding-down clips are different.

4. The shifting mount may be secured for sea either fore and aft or athwartship, while the broadside carriage must be secured athwartship.

6-INCH CENTRAL-PIVOT MOUNT MARK III.

Q. What are the principal parts of the 6-inch central-pivot mount Mark III.?

A. The box slide, the top carriage, and the deck pivot, and circles.

Q. Describe the box slide.

A. The box slide is composed of two steel *brackets connected* by transoms. The upper

Plate VI.

CENTRAL PIVOT CARRIAGE

FOR 6 IN. B. L. R.

MARK 3.

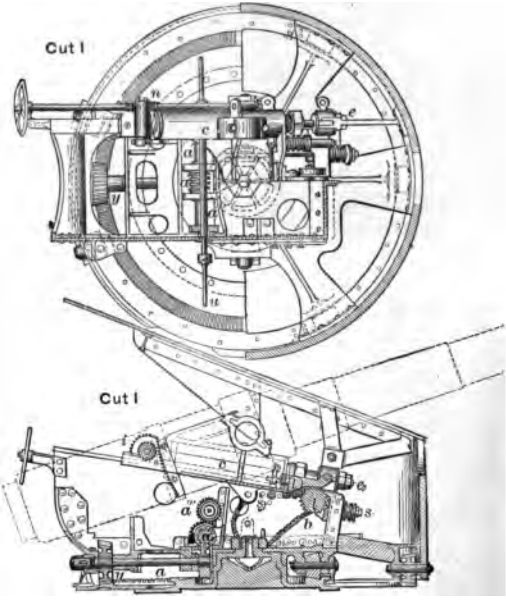

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Plate VIa.

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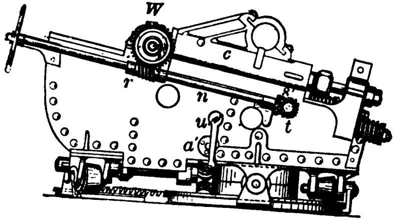

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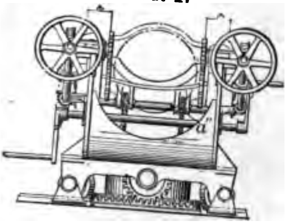

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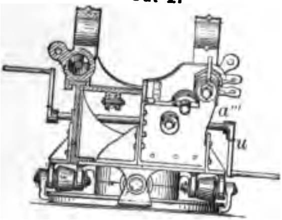


edges of the brackets form T-rails on which the top carriage recoils, and the whole is supported by six coned trucks.

Q. Describe the top carriage.

A. It is a bronze casting composed of two brackets containing the trunnion seats and recoil cylinders, and connected by a vertical transom.

Q. How are the recoil cylinders and pistons fitted?

A. The rear end of each cylinder has a bonnet which screws in place. The ends are connected by a small equalizing pipe to secure smooth and even recoil. The cylinders are rifled with three grooves of varying cross section. The bronze pistons screw onto piston rods, which pass out of the front end of the cylinders through stuffing-boxes, and are secured by nuts to the piston-rod lugs on the slide. Guides with side clips are planed out under each cylinder to fit the T-rails on the slide. Filling and draining holes are bored in each cylinder.

Q. Describe the deck pivot and circles.

A. This is a steel casting bolted to the deck, having at its center a large cylindrical pivot fitting into a cylindrical socket on the slide.

There are two circular tracks on which the trucks bear, and a rack into which the training-gear works. Flanged clip circles around the outer circumference, and clips on the slide, secure the gun in place.

Q. How is the gun trained?

A. By a training-crank connected by cogged gearing with the rack on the deck pivot and circles.

Q. How is the gun elevated?

A. By hand wheels and cogged gearing, which does not recoil with the gun.

Q. How is this accomplished?

A. Two longitudinal shafts, one on each side of the gun, have bearings on the brackets of the slide, and are connected at their front ends by a transverse shaft and miter wheels. The rear ends are fitted with the elevating hand wheels. The elevator brackets, secured to the top carriage, are bronze castings which form the bearings for the elevator axles. These axles carry an arc pinion on one end, and a worm wheel on the other. The longitudinal shafts pass through worms which gear into the worm wheels on the elevator axle. These worm wheels are secured to the longitudinal shafts by feathers fitting into long slots, and have

bearings in the elevator brackets. When the gun is fired these worms recoil with the top carriage along the longitudinal shafts.

Q. What other fittings has this carriage?

A. Preventer wire-breeching, for use in case the hydraulic recoil should fail.

Turn buckles, for keeping the gun in battery when not in use, friction disks, and a holding-out cone.

Q. What is the object of the holding-out cone?

A. It keeps the gun in the firing-position when the ship is rolling. It consists of a ratchet wheel on the slide, with which a pawl on the top carriage engages when the gun is run out. This ratchet wheel is prevented from revolving freely by coned friction-bearings on its shaft, which can be tightened by means of a nut.

6-INCH CENTRAL-PIVOT CARRIAGE MARK IV.

Q. How does the 6-inch central-pivot carriage Mark IV. differ from the 6-inch central-pivot carriage Mark III.?

A. The slide is a single casting.

8-INCH CARRIAGES.

Q. What are the four kinds of 8-inch gravity return hydraulic recoil carriages in use?

A. The barbette carriage, the half-turret carriage, the central-pivot carriage Mark III., and Mark IV.

Q. What type of carriage is the barbette carriage?

A. The barbette carriage is a central-pivot carriage fitted in the earlier ships of the new navy. It resembles in its general features the 6-inch Mark III. central-pivot carriage, but is fitted with elevating-gear like that on the 6-inch shifting-carriage, which recoils with the gun. It is also connected by means of a vertical shaft through its central pivot with a steam engine below. This engine is controlled at the gun, so the gun may be trained either by steam or by hand.

Q. What type of carriage is the half-turret carriage?

A. It is a central-pivot carriage adopted for use in the half-turrets of the U.S.S. *Chicago.* This carriage is similar to the 6-inch central-pivot carriage in its general features. Its training-gear is the same as the 6-inch shifting-carriage.

Q. What types of carriages do the 8-inch central-pivot carriage Mark III. and the 8-inch central-pivot carriage Mark IV. closely resemble?

A. The 6-inch central-pivot carriage Mark III. and the 6-inch central-pivot carriage Mark IV.

RAPID—FIRE MOUNTS.

Q. What two kinds of rapid-fire mounts are in use?

A. The hydraulic recoil rapid-fire mounts and non-recoil rapid-fire mounts.

Q. What guns are mounted on non-recoil mounts?

A. The light 1-pounder, the 37 and 47 mm. revolving cannon, and the Gatling gun.

Q. What non-recoil mounts are in use?

A. Lower mounts, cage stands, rail sockets, and top-mounts.

Q. What are the two essential features of all of these?

A. 1. A Y-shaped saddle in which the gun rests by its trunnions.

2. A socket in which the trunnion of the saddle rests to hold it vertical.

This socket is bolted by a flange to the deck or rail in the cage stands and rail sockets. In top *mounts and* lower mounts this socket is *mounted on* rollers, thereby increasing the train

Q. What hydraulic recoil rapid-fire mounts are in use?

A. 1-pounder Mark I. and II.; 3-pounder Mark II. and III.; 6-pounder Mark II. and III.; 4-inch Mark II. and III.; 5-inch Mark II. and III.; and the 6-inch Mark V.

Q. What are the principal parts of the 4-inch rapid-firing hydraulic recoil mount Mark III.?

A. The pivot stand (*A*), top carriage (*B*), oscillating-slide (*C*), and the combined sleeve and recoil cylinder (*D*).

Q. What is the pivot stand?

A. The base upon which the mount rests. It is bolted to the deck, and carries in a circular path on its upper surface the rollers (*E*) which support the top carriage. The pivot bolt (*G*), around which the movable carriage revolves, screws into a hole at its center.

Q. How are the rollers arranged?

A. A number of coned steel rollers travel in a circular path, and are kept at a regular distance apart by a bronze casting (*F*), which contains their bearings.

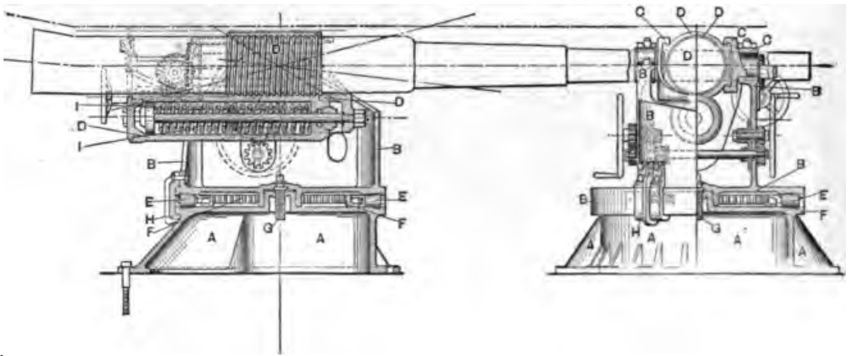
Q. What is the top carriage?

NOTE.— *Q. How does Mark IV.-4" R. F. differ from Mark III.?*
A. The sleeve and two recoil cylinders are in one. Near the breech is a band to which the two piston-rods are secured. The gun recoils through the sleeve, and the shock is taken up by the liquid and springs in the cylinders.

Plate VII.

4 INCH RAPID FIRE MOUNT.

MARK 3.



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A. A steel casting composed of a circular base and two brackets. The base rests upon the rollers, and is bored at its center for the pivot bolt. It carries the clips (*H*) which secure the top carriage to the pivot stand. A band of sheet iron is secured around it to protect the rollers. The brackets are bored for the trunnion seats, and carry the training-gear, which is composed of two hand wheels, connected by cogged gearing with a circular rack on top of the pivot stand.

Q. What is the oscillating-slide?

A. A casting composed of two brackets and a vertical transom. The brackets have trunnions on their outer faces which rest in the trunnion seats of the top carriage; on their inner faces are the guide lips of the slide. The left bracket carries the elevating-arc. To the vertical transom the recoil piston rod is secured.

Q. What is the combined sleeve and recoil cylinder?

A. A solid casting composed of a sleeve which screws onto the gun, a recoil cylinder in which the piston works, and guides which fit between the guide lips of the oscillating-slide.

Q. What is the function of the sleeve and recoil cylinder?

A. It is fixed to the gun, and recoils with it. The piston remains fixed while the guides move along the slide.

Q. How is the gun returned to the firing-position after recoil?

A. Strong spiral steel springs (*I*) in the recoil cylinder are compressed by the piston during recoil, and by their expansion return the gun to battery after recoil is stopped.

Q. How is the gun elevated?

A. By a hand wheel on the left side of the gun, connected by a worm and cogged gearing with the elevating-arc on the oscillating-slide.

4–INCH RAPID–FIRING HYDRAULIC RECOIL MOUNT MARK II.

Q. How does the 4-inch rapid-firing hydraulic recoil mount Mark II. differ from the same mount Mark III.?

A. The training and elevating gear was supported by a directing-bar. Two concentric shafts, with hand wheels at their outer ends, were placed beneath and to the left of the gun. These shafts are connected by worms with the training and elevating gear.

5-INCH RAPID-FIRING HYDRAULIC RECOIL MOUNT MARK II.

Q. How does the 5-inch rapid-firing hydraulic recoil mount Mark II. differ from the same mount for 4-inch rapid-firing guns?

A. It has two counter-recoil spring cylinders cast on the sleeve. The vertical transom of the oscillating-slide has three piston rods secured to it, the middle one being the recoil piston rod, the other two the spring counter-recoil rods.

5-INCH RAPID-FIRING HYDRAULIC RECOIL MOUNT MARK III.

Q. How does the 5-inch rapid-fire hydraulic recoil mount Mark III. differ from the same mount for 4-inch guns?

A. In the same way that the 5-inch Mark II. differs from the 4-inch Mark II.; that is, in having two counter-recoil spring cylinders.

6-INCH RAPID-FIRE HYDRAULIC RECOIL MOUNT MARK V.

Q. How does the 6-inch rapid-fire hydraulic recoil mount Mark V. differ from the 4-inch rapid-fire mount Mark III.?

A. 1. There are two counter-recoil spring cylinders which are not cast with the sleeve, but are bolted to it, and supported by a bronze yoke with eyes which fit around the gun.

2. The elevating-gear is fitted with a friction disk and brake.

8-INCH RAPID-FIRE HYDRAULIC RECOIL MOUNT.

Q. How does the 8-inch rapid-fire hydraulic recoil mount differ from the 4-inch rapid-fire mount Mark III.?

A. These mounts are designed for mounting in turrets. There are two counter-recoil spring cylinders bolted to the sleeve; the sleeve and recoil cylinder are one steel casting. The top carriage is not movable, but consists of two brackets with trunnion seats bolted to angle irons on the flooring of the turret. In the center of the trunnions of the oscillating-slide, knife edges are fitted which rest on straight steel bars attached to the top carriage. The elevating-gear is so fitted that it can be operated from the coning-tower of the turret.

TURRET MOUNTS.

Q. How are 10, 12, and 13 inch guns usually mounted?

A. In turrets, on hydraulic mounts.

Q. What are the principal parts of an hydraulic mount?

A. The saddle, recoil cylinder, slide, deck lugs, and turret girders, elevator, gun-working motors, rammer, and ammunition hoist.

Q. What is the saddle?

A. A heavy bronze casting, secured to the gun by front and rear straps, resting upon and secured to the slide rails by clips and gibs.

Q. What is the slide?

A. A heavy box-shaped steel casting with two side rails, planed to fit the saddle. It is pivoted at its front end to the deck lugs, and near the rear end to the connecting-rod of elevator piston.

Q. What are the deck lugs?

A. Heavy steel castings bolted to the turret floor and girders, and supporting the front end of the slide.

Q. What are the turret girders?

A. Heavy steel plates placed vertically across, and forming permanent fixtures in the turrets. They have broad flanges bolted to the turret floor and form the side brackets for the support of the moving parts of the gun mount.

Q. How is the gun elevated and depressed?

A. By an hydraulic cylinder suspended from the turret girders and the rear end of and under the slide, with a piston and connecting-rod pivoted to the slide.

Q. What is the recoil cylinder?

A. A steel cylinder bolted to the rear end of the slide, midway between its rails. It has three rifled grooves on its inner surface, widest at the front end for the passage of the water. These grooves gradually decrease in width until they close at a point near the rear end of cylinder.

Q. How is the recoil of the gun taken?

A. The recoil cylinder piston is secured to a heavy lug on the gun saddle. When the gun is fired it recoils, carrying the saddle, and the piston is forced into the cylinder, the force of recoil being taken by the restriction of the water in passing from the supply to the reverse side of the piston, through the grooves.

Q. How is the cylinder kept full?

A. Water is forced into it by hydraulic pressure, entering at the rear end, and can only escape from the front end, as there is a check valve on the supply pipe which closes when recoil takes place. As the piston and rod enter

the cylinder the water displaced escapes by spring valves on the front end of cylinder, set at 600 pounds.

Q. What other method of checking recoil is sometimes used?

A. By a similar recoil cylinder placed at the front of the slide, midway between the rails. It has no connection with the hydraulic system, being a closed receptacle filled with glycerine mixed with 20 per cent of fresh water. The piston rod is drawn out when the recoil takes place, or the gun is run in, and the recoil is checked by the restriction of the fluid in passing from one side of the piston to the other.

Q. What is the amount of recoil in 10, 12, and 13 inch guns?

A. With all calibers it is approximately 3 times the number of calibre in inches.

Q. What are the gun-working motors?

A. Hydraulic motors at the rear of the slide, one on each side, the piston rods of which are secured by nuts to the gun saddle. By admitting the pressure on one side or the other of the piston, the gun is forced in or out.

Q. When gun motors are not used, how is the gun run in?

A. By gravity; the breech of the gun is depressed, and it runs in by its own weight.

Q. *How is the gun returned to battery after firing?*

A. As soon as the gun is at rest after recoil, pressure is admitted to recoil cylinder in rear of piston, and the gun forced out.

Q. *How is the ammunition supplied?*

A. By a loading-car, which is hoisted from the handling-room by an hydraulic motor.

Q. *What is the action of the hydraulic ammunition hoist?*

A. It consists of an hydraulic cylinder with piston of about 5-feet stroke. On one end of cylinder is a threefold block, and on end of piston a similar one. A stout wire rope is rove through the sheaves of the two blocks, the standing part being secured to the cylinder head, and the other end to the ammunition car.

Q. *What is the ammunition car?*

A. A bronze casting, usually with three compartments: one, the lower, to hold the projectile; the others to hold the two sections of the charge.

Q. *How is the gun loaded?*

A. The projectile and charge being placed in the car in the handling-room, pressure is turned

upon the hoist motor; the piston rod moving out the cylinder, the fall acts, and the car rises, being supported in vertical guideways until opposite the breech of the gun, when first the projectile, and then the several sections of the charge, are forced into the gun by an hydraulic rammer.

Q. What is the hydraulic rammer?

A. It is a bronze telescopic water motor, placed on brackets, and supported by transoms in rear of the gun; the axis of the rammer is in the prolongation of the axis of the gun when in the loading-position (10° elevation). It is supported on hollow trunnions, through which it receives and discharges water, and upon which it is turned to the vertical position when the gun is fired.

Q. How is the hydraulic pressure secured for the several motors of hydraulic mounts?

A. By a high-pressure pump, usually located in the engine room, and maintaining the required pressure in a reservoir, with circulating-pipes, delivery and exhaust, to the several motors.

Q. What pressure is usually maintained?

A. Usually 600 pounds to square inch, though in some cases 1,000 is used.

Q. How is the pressure transmitted to the revolving parts of the mount mechanism?

A. Main supply and exhaust pipes connect to a water collar, which is mounted on an upright spindle in the center of the turret. This collar revolves about the spindle with the turret, carrying auxiliary supply and exhaust pipes from which the several motors are supplied.

Q. How are the motors controlled?

A. Each motor has its supply and exhaust pipe connected with the auxiliary pressure and exhaust pipe; and each pipe is supplied with a balanced piston valve controlled by hand levers, so as to shut off entirely or admit the pressure to one side or the other of the motor piston.

Q. How are turret guns trained?

A. By revolving the turret.

Q. How is the turret revolved?

A. Usually by steam machinery, operated and controlled from the sighting-hood.

Q. What is used in more recent designs for turret-turning, ammunition hoists, and elevating-mechanism?

A. Electric motors.

CHAPTER V.

SECONDARY BATTERY GUNS AND MOUNTS.

Q. Of what guns does the secondary battery consist?

A. Of Hotchkiss and Driggs-Schroeder 1, 3, and 6 pounder. Rapid-fire guns, Hotchkiss revolving cannon and Gatling guns.

Q. For what purpose are guns of the secondary battery used?

A. Against exposed bodies of men and uncovered decks, to cover landing parties, or protect flanks of a boat expedition, and against torpedo boats.

Q. For what other purposes are these guns sometimes used?

A. To find the range.

Q. How are they used in finding the range?

A. Estimate as accurately as possible, fire a shot, and *increase* or decrease by 150 yards, *until the target* is included between two shots.

Q. Where are they usually mounted on shipboard?

A. In the tops and on the bulwarks forward and aft.

THE HOTCHKISS RAPID–FIRING GUN.

Q. What size Hotchkiss guns are generally found on board ship?

A. The 1, 3, and 6 pounders.

Q. Are these the largest guns of this type?

A. No; they are made as large as 6-inch; but so far none larger than the 6-pounder has been mounted on board our ships.

Q. How is the gun proper constructed?

A. The 1-pounder is a single piece, while the 3 and 6 pounders consist of a tube extending from the face of the muzzle to the front of the breech block, over the rear part of which, and extending about two-fifths its length, is the jacket, the two being locked together by the locking-ring, which is screwed into position.

Q. In what part of the gun is the breech block?

A. In the jacket.

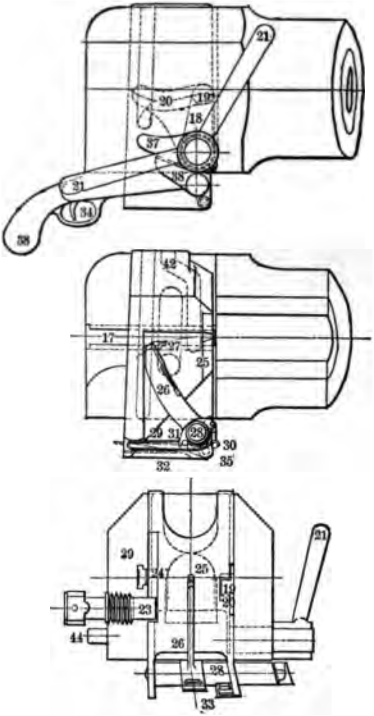
Q. What is the breech block?

A. It is a square hollowed steel block with rounded corners, fitting in a vertical mortise cut completely through the jacket.

Plate VIII.

HOTCHKISS RAPID FIRING GUN.

Breech Action.



To face page **63.**

Q. Are the faces of the block perpendicular to the axis of the bore?

A. The front face is; but the rear face is slightly inclined, to facilitate the working of the block.

Q. How is the top of the block arranged?

A. It is rounded out to aid in loading, and the front corner is cut back to allow free movement to the extractor.

Q. What gives the motion to the block?

A. In its right side are grooves so arranged that a stud (*19*) on end of a crank (*18*) journaled in the side of the breech, working within, not only moves the block up and down, but locks it when it is up.

Q. How is this crank actuated?

A. On the outer end of its axis two crank handles (*21*) are so fitted that by pulling the top handle the breech is opened, and by pulling the bottom handle it is closed.

Q. What else is secured to this axis?

A. A small spring catch to hold the breech closed, and a cocking-cam (*37*), which takes against an arm(*36*) on the rocking-shaft.

Q. What prevents the block from dropping out of its mortise?

A. It is held in place by a stout bolt (*23*) screwed through the left cheek of the breech, the inner end of which fits into a groove (*24*) in the left face of the breech block.

Q. What is this bolt called?

A. The stop bolt.

Q. What other use is made of it?

A. Its free end is used in securing the stock.

Q. In what part of the block is the firing mechanism?

A. In the lower, or hollowed part.

Q. Of what does it consist?

A. Of a rocking-shaft (*28*), hammer (*26*), sear (*32*), trigger (*34*), and mainspring (*29*).

Q. What is the rocking-shaft?

A. It is a shaft in the lower part of the breech block, and to which the hammer and cocking-arm are rigidly attached.

Q. What is the hammer?

A. It is a flat steel bar mounted in the middle line of the breech block, on the rocking-shaft, and having a detachable firing-point (*27*), which explodes the cap through a hole in the *face plate* (*25*).

Q. What is the sear used for?

A. The end of the sear catches in a cock notch (*35*) on the axis of the hammer, and, being actuated by a spring (*33*), holds the hammer at full cock.

Q. How is the trigger fitted?

A. It is an ordinary trigger, the elbow being just above the finger clutch in the pistol grip, and when the breech is closed its forward end takes on the free end of sear.

Q. How is the mainspring fitted?

A. It is a flat steel spring folded over, a lug on the end of the upper fold taking in notch (*31*) on the crank shaft, and the end of the lower fold taking on hanging stirrup (*30*) secured to shaft directly opposite from the notch.

Q. What is the advantage of a spring so fitted?

A. Both arms of the spring give force to the hammer.

Q. How is the bend of the spring secured?

A. It is backed into a seat, which allows free motion to the arms.

Q. Is the extractor connected with the firing-mechanism?

A. No; it is entirely separate.

Q. How is it fitted?

A. It fits in a groove (*39*) on the interior of left side of the breech, which is parallel to the bore of the gun, and receives its motion from a stud on its after end, taking in a groove (*42*) on the left side of the block.

Q. How is the breech opened?

A. By pulling the crank handle to the rear.

Q. How does this affect the firing-mechanism?

A. The groove (*20*) for the crank lug is so arranged that the first part of the movement of the handle does not lower the block, but the cocking-cam taking against arm on rocking-shaft turns the shaft, and allows the sear to catch on the cocking-notch, which holds the hammer at a cock; further movement of the handle brings the crank to the inclined groove, when the block descends.

Q. How does the lowering of the block affect the extractor?

A. As the block is lowered, the stud on the extractor follows its groove (*42*), which is so arranged that the backward motion of the extractor is slight until the cartridge head is clear, when it is drawn quickly to the rear, throwing the cartridge clear of the gun.

Q. How is the gun loaded?

A. A cartridge is run into the chamber until its head takes against the extractor hook.

Q. How is the breech now closed?

A. By pulling on the lower handle, the block begins to move upward; the inclined part of the forward face, acting on the cartridge, forces it into the chamber, and when the breech is closed the face of the block bears tight against the head of the cartridge, and the hammer is in position to fire.

Q. How is the gun fired?

A. By pulling the trigger, the top branch of which presses down on the sear, releases it from the cock notch, and the hammer, under the action of the mainspring, drives forward, and strikes the primer.

Q. Can the gun be fired before the breech is closed?

A. No; the firing-pin is not in line with the primer, the trigger will not act on the sear, and the shaft arm will catch on the cocking-cam.

Q. When the gun is fired, is there any danger of the breech flying open?

A. No; it is held in place by its own weight *and a small spring* catch.

Q. How are the sights placed on these guns?

A. On the right side.

Q. What is the forward sight?

A. It is a roughened point, and is screwed into its seat in the locking-band.

Q. What is the rear sight?

A. It is a bar with rack, and is raised and lowered by a T-handle pinion.

Q. How is the head of the bar made?

A. It is fitted with sliding-leaf to correct for the wind, moving ship, or moving target.

Q. How are the sights graduated?

A. In hundred yards and portions of hundreds.

Q. Is the rear sight of the 1-pounder fitted with the sliding-leaf?

A. No; it has an entirely different sight; a folding-leaf with points and notches for regular divisions of range.

Q. Are the rear sights set vertically?

A. No; they are slightly inclined to the left, to overcome the drift of the projectile.

Q. How are these guns sighted?

A. They are full-sighted; that is, for exact aim the point of the fore sight must be brought in line with the top edge of the sight notch.

Q. If the gun is aimed with a fine sight, what nappens?

A. The projectile will strike about 100 yards short.

Q. What is the stock of the gun?

A. It is a shoulder brace to steady the gun in firing.

Q. How is it fitted?

A. It is attached to the left side of the gun by three fastenings, — the stop bolt, the stock bolt, and the stock pin. On its vertical arm is a buffer of rubber tubing to protect the gunner against the shock of discharge.

Q. How is the lower part of the stock arranged?

A. It is fitted with handles to aid in holding the gun steady.

Q. What is sometimes attached to the arm of the stock?

A. A deflector, to prevent the extracted cartridge cases from falling on the feet of the gunner.

Q. How is the firing-hand of the gunner braced?

A. The *trigger* is inclosed in a pistol grip *(38) attached* to the right side of the breech.

Q. Can this gun be fired by a toggle a laniard?

A. Yes; there is a hole through the pist grip for the laniard.

Q. How are these guns mounted on boa ship?

A. In towers, in broadside, and the 1-pound on the bulwarks.

Q. What two classes of mounts are used?

A. The non-recoil[1] and the recoil moun

Q. What is the common type of non-rec mount?

A. It consists of a pivot clutch, in the ar of which the trunnions rest, giving the verti motion; and the clutch, being a pivot, allows t piece to move laterally.

Q. How is the gun steadied on the mount?

A. The mount is fitted with trunnion a pivot clamps.

Q. How is the gun mounted for shore servic

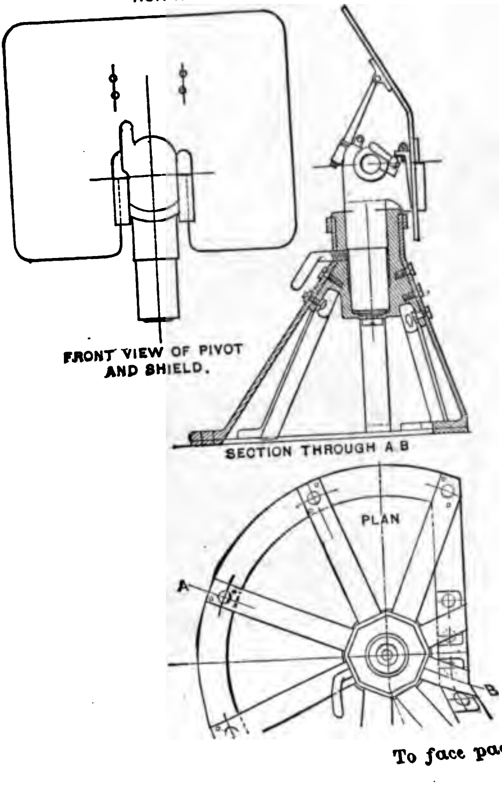
A. It has a fixed carriage, and when mounted the stock is removed.

Q. In what case is it better to have a rec mount?

[1] *Non-recoil* mounts are being replaced by recoil mou

Plate IX.

NON-RECOIL MOUNT.



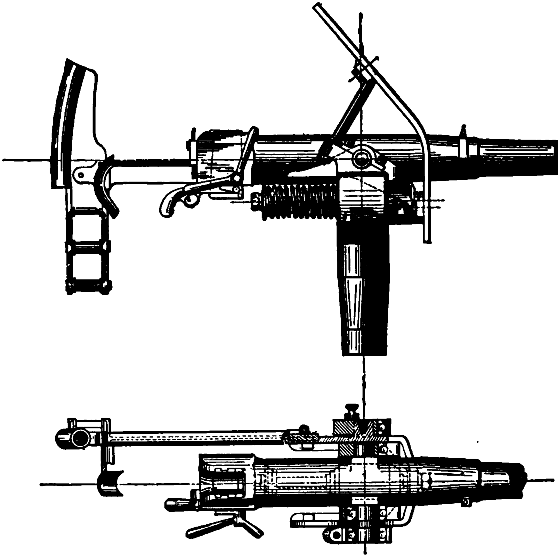
FRONT VIEW OF PIVOT AND SHIELD.

SECTION THROUGH A.B

To face page 70

Plate X.

HOTCHKISS, 3-PDR., RECOIL MOUNT.



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A. On light decks, steam launches, and torpedo-boats.

Q. What recoil mount for the 3-pounder and 6-pounder is now being introduced?

A. It consists of a single hydraulic and spring recoil cylinder, which, together with the carriage proper, is rigidly secured to the gun, the free end of the piston being attached to the "slide." The "slide," resting on trunnions, gives the vertical motion to the gun.[1]

Q. What is the action of this carriage when the gun is fired?

A. The gun recoils to the rear, the carriage moving along the slide. The recoil is taken up by the hydraulic recoil cylinder, and the springs are compressed until the recoil is overcome, when they extend, forcing the gun to battery.

Q. What projectiles are used in the service of the gun?

A. Common cast-iron shell, steel armor-piercing shell, and case shot.

Q. How can you distinguish between the common and steel shells?

A. By the difference in shape of point: the steel is *sharp*, and the common is cut off.

[1] See Plate VII.

Q. What is inserted in the cartridge between the base of the shell and the charge?

A. A felt wad.

DISMOUNTING AND MOUNTING.

Q. How is the gun dismounted?

A. 1. *The Stock.* — Turn the stock bolt and the stock screw a quarter turn with the dismounting-tool; the stock is then loose, and will come off the gun.

2. *The Breech Block.* — The breech being closed, unscrew the stop bolt about four turns. Start the crank handle back, and ease the block down out of its guides, holding it with the hands as it comes out of the mortise.

The mechanism may be dismounted with the breech block in or out of the gun. First uncock the hammer. If the breech is closed, and the gun not loaded, this will be done by pulling the trigger; if the breech is open, or the breech block out of the gun, it will be done by pressing down on the sear.

3. *The Mainspring.* — Insert the point of the screwdriver in the seat of the bend of the mainspring, so that the fulcrum side of the blade of the screwdriver will be flat on the branch of the spring; press down, and slip the stirrup off

the end of the spring; take out the mainspring; turn the stirrup to a horizontal position so as to unlock the rocking-shaft.

4. *The Hammer.* — Pull out the rocking-shaft, and remove the hammer.

5. *The Sear.* — With the point of the screw-driver back out the sear spring, which is dove-tailed in its seat; take off the sear.

6. *The Crank.* — Take out the locking-screw in the hub of the crank handle, and pull the latter off the stem of the crank; take out the crank.

7. *The Extractor.* — Withdraw the extractor from its groove.

THE DRIGGS–SCHROEDER GUN.

Q. What guns of this type have been made for the navy?

A. The 3-pounder and 6-pounder have been completed, and the 36-pounder, or 4-inch, is now being constructed.

Q. Of what does the gun proper consist?

A. Of the tube and jacket.

Q. How are the parts assembled?

A. The jacket being composed of two parts, the forward or inner part (the sleeve) is shrunk

There are at present two types of firing mechanism, which, though corresponding in general system, differ in several important details. These differences are as follows: —

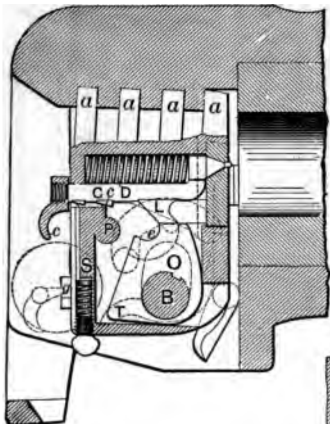
Detail.	Old Standard Model.	1893 Model.
Firing point	Made with rear-projecting spring ears, which clasp the end of the hammer.	Made with a spring-split shank which seats in the head of the hammer.
Main spring	A double-branched flat spring whose ends are caught on opposite sides of the hammer axle.	A spiral spring which acts on a lug projecting from the hammer axle.
Sear spring	Flat	Spiral.
Extractor	Nib and body in a single piece	Nib separate from the body and having a slight spring movement to aid extraction and resist shocks.
Stop bolt	Screws into its seat	Held in its seat and also held, when partially withdrawn, by a spring.
Trigger	Of the ordinary bent-lever form, one end resting on the end of the sear.	None at all, the sear being actuated direct by a firing lanyard.
Cocking toes	Arranged to cock by downward pressure.	Arranged to cock by pressure to the rear.
Pistol grip	Ordinary type secured to the right lower side of the breech.	None at all.
Rear sight	Screwed permanently to face of breech.	Clamped to face of breech, permitting instantaneous removal and clamping.
Crank handle	Permanently attached to crank-shaft by feather and keep-screw.	Attached to crank-shaft by square head and snap-spring. Removable and interchangeable.

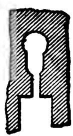
Plate XI.

THE DRIGGS-SHROEDER R. F. GUN.

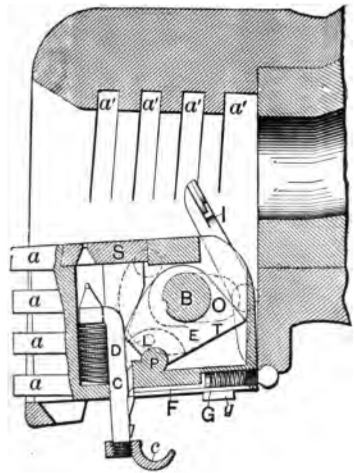
BREECH MECHANISM.

BREECH CLOSED.





BREECH OPEN.



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on the tube, the parts being connected under the trunnion band by screw threads.

Q. What arrangement is there for transferring to the trunnions the thrust imparted by the rifling?

A. There is a jog in the adjacent surfaces of the tube and sleeve.

Q. How is the breech mechanism fitted?

A. It is contained in the rear end of the jacket, which forms a natural housing and protection for it.

Q. Of what does the breech mechanism consist?

A. Of the breech block and firing-mechanism, together with the extractors.

Q. What is the breech block?

A. It is a steel block (*C*) recessed from its under side, and fitted on its upper surface with locking-bands (*a*), and on either side with grooves and guideways.

Q. How is it held in place?

A. By the cam (*E*), by stud and guidepins, taking in the side-grooves, and when up, by the upper bands taking in corresponding grooves on interior of jacket.

Q. How is the cam fitted?

A. In a recess in the center of the block, and is mounted on the crank bolt (*B*), which, extending through the block and both jaws of the jacket, has attached to its left end the crank handle.

Q. Does the crank bolt fit snugly through the block?

A. No; it works in an elongated opening (*o*), which aids in opening the breech.

Q. What opens and closes the breech?

A. The action of the cam on the interior of the block.

Q. How is the firing-pin fitted?

A. In a cavity of the block over the cam recess, and extends longitudinally through the block.

Q. How is it arranged?

A. It has an upturned head, on the forward end of which is the firing-point, and against the shoulder of which the mainspring takes. On its under side is a projecting lug (*L*) taking into a groove on the cam, and two cocking-notches.

Q. How is the firing-pin held at a cock?

A. To the rear of the block is grooved the *sear*, which, actuated by a spring, catches on the cocking-notches.

Q. How is the trigger fitted?

A. In a pistol grip secured to the right side of the breech, and its forward end takes against sear-lug when the breech is closed.

Q. How are the cartridges extracted?

A. By two extractors (*I*), one on each side.

Q. How are the extractors fitted?

A. They revolve on projecting arms fitted into the cheeks of the jacket, and have on their lower end a projection which, taking in the groove on the side of breech block, gives them their motion.

Q. How is the breech opened?

A. By turning the crank handle through about 90° to the rear.

Q. What is the action of the mechanism?

A. The first movement of the crank handle turns the cam (*E*), which, taking on firing-pin lug (*L*), clears the firing-point, and allows the block to drop. The cam now turning its toe (*T*), pressing on bottom of breech block, forces the block downward, its motion being controlled by the upper surface of the cam sliding along an inclined wall, and by the guide bolts on either side. When the bands (*a*) are clear, the *main bolt* having reached upper end of elongated

opening (*o*), the block ceases to drop, and a further movement of the handles revolves the cam, forcing the firing-pin (*c*) to the rear, and cocking it. A recess in cam now taking on a round pin (*P*) in rear interior of block, forces the block to revolve with the cam, thus swinging open the breech.

Q. How does opening the breech affect the extractors?

A. The first movement of the handle causes the block to exert a powerful leverage on the extractors (*I*), moving them just enough to start the cartridge; and when the breech is clear, the moving becomes abrupt, which throws the case sharply to the rear.

Q. How is the breech closed?

A. By a reverse action of the handle.

Q. How is the gun fired?

A. By pulling the trigger, which, pressing down on sear (*F*), releases the cocking-notch (*c*), and the firing-pin, under the action of the spiral mainspring (*D*), drives forward, and explodes the cartridge.

Q. Can the gun be fired before the breech is closed?

A. No; the trigger is not in place, and the *firing-pin* is not in line.

Q. Can the gun be brought to a half or full cock without opening and closing the breech?

A. Yes; the firing-pin extends through the block, and has attached to its after end a finger catch (*c′*), by which it can be readily drawn to the rear.

Q. Of what advantage is this?

A. The gun may be left loaded and half cocked without danger of accidental discharge, and a cartridge may be tried a second time without moving the block or handle.

Q. How is the gun steadied in firing?

A. By means of a shoulder piece attached to its right side.

Q. What advantage is there in having shoulder piece on the right side?

A. The operation of loading does not interfere with the line of sight.

Q. How are these guns sighted?

A. By two sights on right side of gun.

Q. How are the sights arranged?

A. The forward sight is secured to trunnion band, and the rear sight, fitted with sliding-leaf, is moved up and down by means of a rack slide and a T-handle pinion.

Q. How are the guns mounted?

A. On non-recoil and recoil mounts.

Q. What type of non-recoil mount is used?

A. It consists of a pivot clutch, in the arms of which the trunnions rest, giving the vertical motion; the clutch being a pivot, fitted with a white metal disk, gives the lateral motion with little friction.

Q. How is the gun secured when not in use?

A. It is fitted with trunnion and pivot clamps.

Q. How is the trunnion clamp arranged?

A. An arm is rigidly attached to the right trunnion, and has fitted to its lower end a T-clamp working in a T-slot arc.

Q. What type of recoil mount is now being constructed?

A. A mount which will cause the breech to open and the cartridge case to be ejected automatically.

Q. What ammunition is used in the service of the gun?

A. Central fire-drawn brass cases, with common shell, steel shell, or case shot.

Q. How many shots can be fired per minute?

A. From twenty to thirty.

Q. What main advantage is claimed for this gun?

A. The extreme lightness of the breech block as compared to other rapid-fire guns.

Q. Why is this an advantage?

A. Greater length of gun for same weight, and therefore greater velocity.

DISMOUNTING AND MOUNTING.

Q. How is the breech mechanism dismounted?

A. 1. Clamp the gun.

2. Back out right guide bolt, raise rear end of stock, re-enter guide bolt (not far enough to lodge in guide groove), and let stock down to rest on it. To take off stock entirely, remove its pivot bolt on the Y, and unship it.

3. The block being closed, back out left guide bolt, take off operating-handle, tapping end of axle bolt to start it. Draw out main bolt, ease the block down, holding it with the hands as it is lowered.

4. Full cock, remove face plate, and uncock by bearing down on sear arm.

5. Unscrew finger catch from rear end of firing-pin, and by tipping the block face down, the cam, firing-pin, and mainspring will drop out.

6. Take out sear plug, sear spring, and sear.
7. Unship sight, take out extractors, remove pistol grip, trigger, and rock shaft.

Q. How are the parts reassembled?

A. By proceeding in a reverse manner.

Q. What precaution should be taken with the firing-pin?

A. See it full cocked for putting on face plate, and uncocked to clear tray.

Q. How should the right guide bolt be entered?

A. Ship the stock, and enter the guide bolt through it.

THE HOTCHKISS REVOLVING CANNON.

Q. How are these guns designated?

A. By the caliber.

Q. What calibers are usually found on board ship?

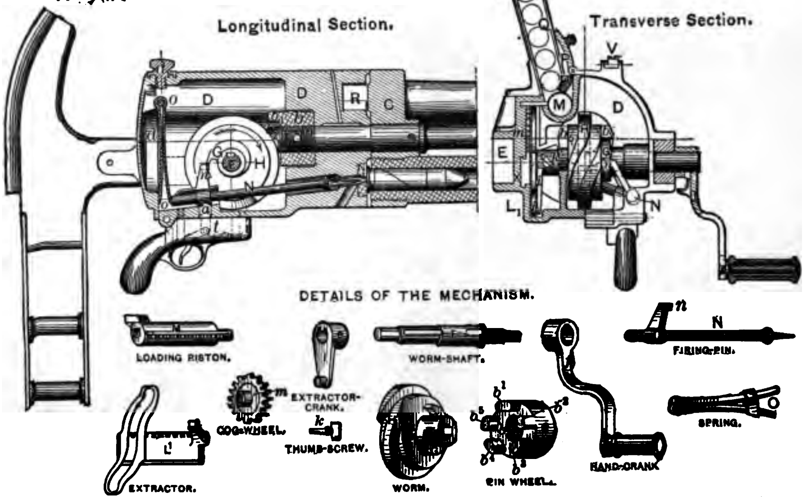
A. The 37 mm., 47 mm., and 53 mm., or the 1.46-inch, 1.85-inch, and the 2.09-inch.

Q. How is the gun proper constructed?

A. Five steel barrels are grouped around a common axis, the whole being secured by a disk at each end, and made to revolve in a rectangular frame which is attached to the bree

Plate XII.

47 m/m HOTCHKISS REVOLVING CANNON.



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Q. How are the barrels secured to the disks?

A. They are screwed into the rear disk (*C*), which is made thick for that purpose, and are snug into the forward disk.

Q. Are the barrels and axis the same length?

A. No; the barrels are flush with the rear disk, and the axis extends through the breech piece (*D*) to receive the rotary motion from the driving-gear.

Q. What is the breech piece?

A. It is a cast-iron block, the front half being solid, to resist the shock of discharge, and the rear half being hollow, to form a chamber for the mechanism. The solid part is pierced with the channels necessary for loading and firing, and the chamber is provided with guideways and journals for the mechanism.

Q. Of what does the mechanism consist?

A. Revolving-gear, loading-piston, mainspring, firing-pin, and extractor.

Q. What is the revolving-gear?

A. A horizontal shaft (*F*) extending through the breech, and operated by a crank attached to its *right* end; has fitted on its center an *irregular* worm-wheel (*H*) gearing with a heav-

steel pin wheel (*b*) secured to rear end of main axis.

Q. What besides the worm wheel is attached to this shaft?

A. On its left side, on the interior of the breech, a small crank (*I*) is attached, the end of which works into a vertical slot in the rear part of the extractor (*L*).

Q. Of what does the extractor consist?

A. A horizontal rack (with nip), which is worked backward and forward in a groove (*X*) on interior of breech by a crank working in slot attachment on its after end.

Q. How is the loading-piston arranged?

A. It is a cylindrical rod (*M*) with a rack arm on its left side, gearing with a fixed cog wheel (*m*), which gears on its bottom with the extractor rack.

Q. How is the mainspring fitted?

A. It is hinged at *O* to inside of the breech door, the outer branch resting against the door, and the inner branch taking against the rear end of the firing-pin.

Q. What is the firing-pin?

A. It is a steel rod (*N*), with forward end pointed, and having near its after end an arm

(*n*), which is kept pressed against a cam (*G*) on right side of the worm by the mainspring.

Q. Is the firing-pin the same for all calibers?

A. Yes; but in the 47 mm. and 53 mm. a spring catch (*a*) is fitted under the firing-pin which takes on arm shoulder, and prevents the pin from driving forward.

Q. What actuates the spring catch?

A. A pistol grip is fitted to these calibers, and the free end of the trigger (*t*) is joined to bottom of catch; and by pulling the trigger the catch is forced down, and the pin freed.

Q. How is the gun fired by means of the crank alone?

A. The catch is forced clear by means of a cut-off on right of the pistol grip.

Q. What is the action of the mechanism?

A. By turning the crank the worm-wheel (*H*) gearing with the pin wheel (*b*) on rear of axis revolves the barrels; the extractor rack (*L*), moved backward and forward by the shaft crank working in the slot, rotates the fixed pinion (*m*), which, gearing on its top with the loading-piston rack (*M*), moves it in the opposite direction to the rack below. The cam (*G*) on the worm wheel continues to

force the firing-pin to the rear until the cartridge is in place, when the arm is released, and the pin is driven forward.

Q. What is peculiar about the mechanism?

A. The barrels remain still during the loading, firing, and extracting.

Q. How can the barrels remain still while the crank is being turned?

A. The thread on the worm wheel is so arranged that it revolves the pin wheel during only half the revolution.

Q. How many times can the gun be fired for every turn of the crank?

A. Only once.

Q. How can time of firing be told?

A. The crank must make a whole turn for each barrel, and by extending the thumb of the left hand, which holds the stock rounds, the crank will pass it just before the gun is discharged.

Q. How is the gun loaded?

A. Through feed trough (*Q*) fitted to the upper left-hand side of the breech.

Q. What regulates the feed?

A. A feed gate (*P*), which hinges over and is actuated by the loading-piston.

Q. Explain the operation of loading and extracting.

A. A cartridge is placed in the trough; the piston pushes it home, when the barrels begin to revolve, and the cartridge is brought before the firing-pin, which, having been forced back by the cam, is now released, and under the action of the mainspring drives forward and strikes the primer. As soon as the cam clears the firing-point the barrels again revolve, and the cartridge is taken to the extractor, which, being in place, takes on cartridge rim; and as the empty shell is being extracted the barrels are again still.

Q. Which barrel fires?

A. The lower right-hand barrel, the firing-pin working through the solid part of the breech.

Q. Where are the cartridges extracted?

A. On the under left-hand side of breech.

Q. How many shots can be fired per minute?

A. From forty to fifty.

Q. How is the gun mounted on board ship?

A. It is mounted generally on a pivot clutch, in the arms of which the trunnions rest, giving the *vertical* motion, and the clutch, being a *pivot*, allows the piece to move laterally.

Q. When the gun is so mounted, how is it held in place when not in use?

A. It is fitted with both pivot and trunnion clamps.

Q. How is the gun held steady in aiming?

A. It has attached to the left side of the breech a stock.

Q. How is the stock fitted?

A. It seats by a tenon in a mortise in the left frame, and is held in place by a spring catch.

Q. How are these guns sighted?

A. The forward sight is an ordinary steel point, roughened and screwed into its seat in forward part of frame.

Q. What is the breech sight?

A. For the 37 mm. it is a folding-leaf with points and notches for regular divisions of ranges.

Q. How is it used?

A. It is raised, and sight taken on the point or notch corresponding to the range wanted.

Q. How is the folding-leaf set?

A. At a slight incline, to allow for the natural *drift of the* projectile.

Q. Is the breech sight of the 47 mm. and 53 mm. the same as the 37 mm.?

A. No; it is a bar, with sliding-leaf head, elevated by pinion and rack.

Q. What projectiles are used in these guns?

A. Case shot, cast-iron and steel shell.

Q. How can the cast-iron be told from the steel shells?

A. The cast-iron shells are fitted with nose fuses, and the steel with base fuses.

Q. Can the cartridge cases be used more than once?

A. Yes; they may be used from ten to fifteen times by reloading.

DISMOUNTING AND MOUNTING.

Q. How is the mechanism dismounted?

A. 1. Open the breech door by unscrewing the door bolt with the right hand; at the same time press the left hand against the door, to prevent the latter from flying open.

2. Withdraw the firing-pin.

3. Detach the mainspring by first turning it completely over, and then withdrawing its keep pin

4. Take out the thumbscrew which secures the extractor crank to the worm shaft (for the 37 mm. alone). Unscrew the holding-screw of the crank-gear cover, remove the cover, unscrew the lock screw of the miter gear wheel, and pull out the crank shaft.

5. Withdraw the worm shaft, and as the extractor crank and worm wheel slip off, remove them.

6. Pull out the extractor and the loading-piston.

7. Unscrew the keep pin of the cog wheel, and take the latter out.

Q. How is the mechanism mounted?

A. In the reverse manner.

Q. What care should be taken with the loading-piston in mounting?

A. Push it as far forward as possible before putting the extractor in place, so that the proper teeth will engage in the cog wheel.

Q. How should the crank be shipped?

A. So that the firing may be guided by the thumb of the left hand.

Q. After the mechanism is dismounted, how is the gun dismounted?

A. Turn the barrels so as to bring the arrow on the rear assembling-disk, marked "Dis-

mount," opposite the arrow on the right upper quarter of the breech piece; remove screw which closes hole in the top of the breech piece, then enter a punch in this hole, and back out the keep bolt of the pin wheel; unscrew and take out the pin wheel; unscrew the four bolts which connect the frame with the breech piece; withdraw the breech piece to the rear; remove the group of barrels from the frame.

Q. How are the parts reassembled?

A. Reassembling is done in the reverse order. Start the pin wheel on before pushing the breech piece entirely into place; in driving in the keep pin of the pin wheel be careful that it is close home, so as not to grind the journal; also, before dropping the keep pin in, turn the barrels until the arrow marked "Mount" is opposite the one on the breech piece.

THE GATLING GUN.

Q. Of what does the Gatling gun proper consist?

A. Of ten breech-loading rifle barrels (*B*) grouped about a common axis (*b*), the whole being secured by a disk (*v*) at each end, and made to revolve in a closed casing (*w*), which also contains the breech mechanism.

Q. Are the barrels as long as the axis?

A. No; they screw into, and are flush with, the rear disk, while the axis extends through breech-casing to receive the rotary motion from the driving-gear.

Q. Of what does the firing-mechanism consist?

A. Of the revolving-gear, carrier block, shell guide, lock guides, lock cam, and locks.

Q. How is the revolving-gear arranged?

A. The rear end of casing is cast to receive a horizontal shaft (*a*) with its driving-worm, which gears with worm (*c*) on main shaft, the hand crank fitting to right end of crank shaft, or directly to end of main shaft.

Q. What is the carrier block?

A. It is a skeleton cylinder (*c''*) with grooves and studs, fitted on the main shaft next to the rear disk.

Q. What is its function?

A. It receives and guides the cartridges during the process of loading and extracting.

Q. What is the shell guide?

A. It is a three-pronged semicircular device (*a'*), the shoulder of which, resting in the extractor gate, and the prongs taking in circular

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grooves in the carrier block, guide the empty cases to the extractor gate.

Q. What are the lock guides?

A. They are skeleton disks (i i') fitted on the main shaft, and guide the locks during the process of loading and extracting.

Q. What is the lock cam?

A. It is a hollow cylinder which fits into rear part of the casing, containing on its interior surface regular grooves (g), and has secured near its bottom the cocking-switch (c').

Q. How are the grooves arranged?

A. So that the lock stud (n) working in them, the lock through the first half turn of the barrels is forced forward, and during the second half turn is drawn to the rear.

Q. How is the cocking-switch arranged?

A. It is secured to the lower inner side of the lock cam, and is fitted at its forward end with a T-slot, into which the head (k) of the firing-pin takes.

Q. Of what does the lock consist?

A. Of a steel tube, through the center of which extends the firing-pin (J), together with the mainspring (s); and to its forward end is attached the extractor (x).

Q. How is the mainspring fitted?

A. It encircles the firing-pin, the forward end resting against shoulder on pin, and its rear end taking against a pin-bushing secured in base of lock.

Q. What actuates the firing-pin?

A. On its rear end is a knob, which, taking in T-slot in cocking-switch while the lock is forced forward, brings it to a full cock, and when the cartridge is home it clears the slot and flies forward.

Q. What gives the forward and backward motion to the lock?

A. A stud (*n*) on its rear end taking in lock-cam grooves.

Q. Can the firing-pin be held to the rear?

A. Yes; through the under side of the lock is fitted a spring pawl (*m*), which takes against notch on the firing-pin.

Q. What is the extractor?

A. A steel nip, grooved in place.

Q. What is the action of the mechanism?

A. By turning the crank, the barrels and locks revolve together. The stud on the downward lock following the cam groove, the lock (*L*) is forced forward until the cartridge reaches

the lower part of the cylinder, when the cocking-switch (c') taking the head (k) of the firing-pin holds it to the rear, while the lock is drawn forward and the cartridge seated, when it is released, and under the action of the mainspring drives forward, discharging the cartridge. The groove (g) now inclining to the rear, the lock is drawn backward, and the cartridge extracted.

Q. How is the operation of loading and extracting divided?

A. When the gun is in action, there are always five cartridges going through the process of loading, and five in different stages of being extracted.

Q. When does the extractor take hold of the cartridge head?

A. The extractors are so arranged that they are pushed forward at the cartridge-receiving point by a cam on the cascabel.

Q. What prevents the firing-pin point from projecting in front of lock face while the lock is going forward?

A. After each shot the firing-pin rebounds, and is held to the rear by a spring pawl (m) on bottom of lock.

Q. What might happen should the point be *free?*

A. There would be danger of premature e: plosion.

Q. How are the cartridges entered?

A. Through a hinged hopper (h') on top (piece.

Q. How are the empty shells extracted?

A. Through a gate (f) under left side (hopper.

Q. Can the cocking-device be thrown out o action?

A. Yes; to the right of the gun is fitted cocking-switch knob, which when turned to tl rear (shown by arrow) forces the T-slot clear (the firing-pin knob.

Q. What advantage is this?

A. It prevents snapping the firing-pins whe the gun is worked for drill or explanation wit: out firing.

Q. Does it make any difference whether thic. or thin-headed cartridges are fed to the gun?

A. It will fire either, but the thickness of tl head must be regulated by the adjuster knc (N′) on end of main shaft.

Q. Is there a way to tell when the adjust(knob is properly set?

A. Yes; after setting up knob as tight as possible, unscrew it until the mark on the knob comes in line with the first line on the driving-ring, which is the mark for thin-headed cartridges; the second mark is for cartridges with thick heads.

Q. *How are the cartridges supplied to the gun?*

A. In feed cases or magazines.

Q. *Of what does the magazine consist?*

A. Of a circular drum (*H*) of a width slightly greater than the length of the cartridge, with the two circular plates (p') which form the end of the drum fitted with spiral grooves running from the center to the circumference, and receiving the ends of the cartridges, and guiding them in and out of the drum.

Q. *How is the center of the drum arranged?*

A. Between the two groove plates are two circular disks (x'), having a number of slots radiating from the center, and joined near the edge by pins (z), which revolve around the center bush.

Q. *How are the cartridges fed from the drum?*

A. Studs (s') on the carrier block engage with the pins (z) that join the disks and revolve the disks, thus forcing the cartridges along the spiral

grooves in the end plates, and out of the drum into the receiver (e').

Q. How is the drum fitted to the hopper?

A. On its sides are studs which take in grooves in the hopper sides; the painted side of drum is turned aft.

Q. How is the gun usually mounted on board ship?

A. On the bulwarks or on light-tripod mounts.

Q. What mount is generally used?

A. It consists of a pivot clutch (R), in the arms of which the trunnions of the piece rest. Through the trunk of the clutch runs a semi-circular, plane, or racked arc (R'), the ends of which are secured to rear end and forward part of casing. Gearing with the arc, if racked, is a pinion actuated by a hand wheel on after part of trunk, so arranged that one turn of the wheel turns one cog, which represents one degree of elevation or depression.

Q. How is the gun held in place when not in use?

A. It is fitted with pivot and arc clamps.

Q. What other carriages have these guns?

A. Field carriages, on which they are mounted *for shore service.*

Q. How is the gun steadied in firing?

A. In a mortise under rear of breech is shipped a directing-bar (*J*), consisting of two bars at right angles to each other, and so joined that the horizontal bar can be raised, lowered, moved up or back, and clamped in any position.

Q. How is the gun sighted?

A. On either side, and is provided with two sights, the front sight being an ordinary sharpened point, and the rear sight a bar and head.

Q. How is the rear sight raised and lowered?

A. By hand, and is held at any elevation by a small spring.

Q. How is it graduated?

A. In hundreds and proportions of hundred yards up to 1,000 yards.

Q. How do the two rear sights differ?

A. The right sight is to be used in firing cartridges of 500 grains, and the left in firing cartridges of 480 grains.[1]

Q. What is the advantage of this gun?

A. It gives a very rapid and effective fire, equal to a large body of infantry.

Q. How many shots can be fired a minute?

A. As many as 1,200 have been fired.

[1] *The new* Gatling guns are of .236 caliber, and use *smokeless powder.*

Q. What ammunition is used?

A. The same as that furnished for the small arms of the ship.

Q. Before firing, what precautions should be taken?

A. 1. The adjuster nut should be at its proper position; viz., with the marks on line with each other.

2. The safety cam (cocking-switch) should be set to fire (arrow head on knob pointing forward).

3. The chamber should be lubricated with tallow.

4. The shell guide should be in place, and the hopper locked down.

Q. Where is the crank handle fitted for rapid firing?

A. On the end, as here ten shots are fired for every turn, while on the side only six are fired.

Q. What arrangement is there for very rapid firing?

A. There is an electricmotor attachment.

Q. What should be done after a long fire to ease the piece?

A. The adjuster nut should be eased a notch *or two.*

Q. What aids in cooling the barrels?

A. Pointing them to the wind.

Q. How many men constitute a crew for the Gatling gun?

A. Four or six; six for very rapid firing.

Q. How are the men exercised?

A. The same as at the Hotchkiss revolving cannon: No. 1 attending the aiming and firing; No. 2, the sights, elevation, and trunnion and arc clamps; No. 3, the feeding (shipping and unshipping the magazine); No. 4 provides filled, and returns empty, magazines; Nos. 5 and 6 provide the ammunition, and fill the magazines, except with crew of four, when this is done by Nos. 3 and 4.

Q. What does No. 3 do when the drum is nearly empty?

A. Calls "Drum;" replaces drum when empty by filled one.

Q. How are the magazines filled?

A. By means of a special feeder.

Q. What is this feeder?

A. It consists of a revolving-center drum, underneath which the magazine is secured by fitting over a horizontal cylinder operated by a *cam handle*, and into the top of which is shipped

a vertical receiver arranged to receive the cartridges direct from the box.

Q. What is the action of the feeder?

A. By turning the crank of the feeder drum, the cartridges, being fed by their own weight, are forced on through and enter the magazine, which is made to revolve by projection on feeder disks taking against the magazine disk pins.

Q. How many cartridges will a magazine hold?

A. One hundred and two.

Q. What accidents are most likely to occur in firing?

A. Breaking a part of a lock, cartridges jamming or exploding.

Q. What is done when a lock is disabled?

A. The firing may be continued with the remaining nine, or it may be replaced by another.

Q. What is done when a cartridge jams?

A. Lift the hopper, and turn the crank until the cause of the jam is found.

Q. How may a headless shell be extracted?

A. Enter the headless-shell extractor in the chamber, and push it forward until the hooks spring over forward edge of shell, when with

brass wiping-rod entered from muzzle drive it to the rear. Never enter the extractor at the muzzle when it can be avoided.

Q. What is contained in supply box of the gun?

A. Spare parts, — lock complete, extractors, firing-pins, mainsprings, cocking-switch springs.

Accessories, — cam extractor, rear guide, nut wrench, cascabel spanner, lock screwdriver, T screwdriver, pin punch, oil can, headless-shell extractors.

DISMOUNTING AND MOUNTING.

Q. How is the gun dismounted?

A. 1. Remove hinge pin, and take off the hopper.

2. Remove the lock plug by turning to the right, and take out the locks.

3. Turn off the adjuster knob by pressing down the catch and turning the knob to the left, or by pressing down the catch and turning the crank in the same direction as when firing.

4. Remove the worm cover, pull out the crank-shaft split pin, and draw out the crank shaft to the right. In this operation the worm will fall through the worm-cover hole, and should be *caught in the* hand.

5. *Take* off the cascabel plate. To do this

first ascertain if the cocking-switch is in its firing-position, which is indicated by the arrow pointing forward. Then turn out the cascabel-plate screw, and turn the plate to the left until the arrows on plate and casing meet; the plate can then be pulled off.

6. Take out the lock cam. First pull the cocking-switch knob outward, turning it to the right until it snaps in the notch, the arrow pointing downward; the cam can now be pulled out, using the cam extractor or the fingers of both hands.

7. Take out the shell guide.

8. Take off the front barrel plate. For this purpose, first push the main shaft forward about six inches, drive out the pin with the drift, then take a piece of soft wood, and place it on the inside rim of the plate, and drive gently with a hammer until the plate starts off.

9. Pull out the main shaft — barrels and all — to the rear; drive out the pin in the rear lock-guide, and pull guide off; do the same with the front lock-guide. Pull off the carrier block, then push the main shaft forward, take hold of it at the front end, and pull it out from the group of barrels.

Q. How are the parts assembled?

A. In the reverse manner.

CHAPTER VI.

PROJECTILES AND CHARGES.

PROJECTILES.

Q. What is a projectile?

A. A mass of metal usually thrown from a firearm by the explosion of a charge of gunpowder or other explosive substance.

Q. What physical properties should a projectile possess?

A. Toughness, hardness, and weight. Toughness, to prevent its being broken to pieces by impact with a solid substance; hardness, in order to penetrate; weight, so that for a given mass it may present the least surface to the air and the resistance offered may be a minimum.

Q. What two forms of projectiles are used?

A. Spherical and cylindrical shell with a pointed head.

Q. In what guns are spherical project used?

A. In smooth-bore guns.

Q. In what guns are cylindrical projectiles used?

A. In rifled guns.

Q. What are the advantages of cylindrical projectiles?

A. They present a diminished surface for equal weight to any resisting medium; and consequently greater range, a flatter trajectory, greater accuracy, and penetration are obtained.

Q. What are the disadvantages?

A. Increased strain on the gun, greater liability of jamming and injuring the bore, irregularity of ricochet, and increased cost of manufacture.

Q. What projectiles are used in B. L. R. guns?

A. Shell and shrapnel.[1]

Q. What two kinds of shell are used?

A. Common shell and armor-piercing shell.

Q. What is the common shell?

A. It is a hollow cast or drawn shell, containing a bursting-charge of powder, exploded

[1] *Rifle* canister have been designed, but none have yet *been issued* to the service.

by a fuse on impact, or at the end of a certain length of time after leaving gun.

Q. Of what material is the common shell made?

A. Of cast iron, or cast or drawn steel.

Q. What is the shape of the common shell?

A. A cylinder, 3¼ calibers in length, with an ogival head of two calibers radius.

Q. What is the shape of the cavity for the bursting-charge?

A. It follows the outlines of the shell, leaving walls about ¼ of a caliber in thickness, except at the base, where it is thicker.

Q. How are drawn shell made?

A. By forging the cylindrical part about a mandrel from cast-steel tubing, and afterwards welding on the head by electricity.

Q. Why is steel being used for common shell?

A. The high pressure on the base sometimes broke up the cast-iron shell in the bore.

Q. For what are cast-iron common shell used?

A. At target practice, with reduced charges.

Q. For what are steel common shell used?

A. Against masonry, earthworks, and unarmored sides of vessels, and are effective by the

force of the explosion, and by setting fire to inflammable material.

Q. Where is the fuse placed?

A. In cast-iron shell, usually in the nose of the projectile; in steel shell, sometimes a nose, and sometimes a base fuse, is used.

Q. What is the armor-piercing shell? [1]

A. It is a forged steel shell with hardened point, formerly containing a small bursting-charge of powder, but no fuse, and used for the penetration of armor.

Q. How was the bursting-charge ignited when used?

A. By the heat generated by the penetration of the shell through the armor.

Q. Of what material is the armor-piercing shell?

A. Of forged, oil-tempered steel, treated by special processes, and containing special alloys, to allow excessive hardness of point in tempering.

Q. What is the process of manufacture?

A. The shell are forged solid, turned to dimensions, then bored out for the bursting-charge, oil-tempered, and the point hardened.

[1] *1, 3, and 6*-pounder R. F. guns, armor-piercing shell, *are loaded and fused* same as common shell. Other A. P. *shells are not now* provided with bursting-charges.

Q. How is the base of the armor-piercing shell closed?

A. By a heavy steel plug screwed into the base.

Q. What is the shape of the head?

A. A sharp point and ogival of two calibers radius.

Q. What is shrapnel?

A. It is of cast iron or wrought steel, similar in shape to shell, but has much thinner walls, and is filled with small leaden balls packed in sulphur, with a small bursting-charge of powder.

Q. For what is shrapnel used?

A. Against boats and exposed bodies of men.

Q. What is the action of the shrapnel?

A. It is intended to explode before reaching the object, the balls and fragments being hurled amongst the boats or men.

Q. Where is the bursting-charge placed?[1]

A. At the base of the shrapnel, and separated from the central part by an iron plate, thus allowing the balls to be driven forward by the velocity they had on bursting, and to scatter.

Q. What is the use of the sulphur?

A. It holds the balls in place.

[1] In new model, bursting-charge is contained in central tube; no burster-bag, the tube being filled with shell powder, and fuse screwed home.

Q. Is shrapnel a single piece?

A. No; the head is screwed on after charging.

Q. What fuse is used in shrapnel?

A. A nose-fuse, the boxer.

Q. What gives the rotation to the projectile of rifled guns in our service?

A. The compression band.

Q. What is the compression band?

A. A band of soft copper, fitted around the projectile near the base.

Q. How does it give the rotary motion to the projectile?

A. The compression slope is larger in diameter than the bore, and the compression band is turned to fit the slope. When the gun is fired the band is forced into the rifling.

Q. What other good purpose does the compression band serve?

A. It prevents the escape of gas around th projectile.

Q. How is the compression band fitted?

A. An undercut score is turned around projectile, and nicked at the bottom with a c chisel. The band, cut to the proper lengt forced into the score by hydraulic pre

Q. What is the purpose of the nicking?

A. To prevent the band from turning.

Q. What remains to be done after the band is fitted?

A. The extractor groove must be turned.

Q. For what is it used?

A. To withdraw the projectile if desired.

Q. How are projectiles issued to service?

A. In wooden boxes, painted different colors to distinguish the several kinds, and marked with the caliber, length of fuse, etc.

Q. What are the colors used?

A. Armor-piercing shell, black; common steel shell, lead color; cast-iron shell, red; and shrapnel, white.

Q. What is the bursting-charge?

A. A small charge of powder placed in the cavity in the shell, and intended, when ignited, to burst the shell.

Q. How is the bursting-charge placed in the shell? [1]

A. It is contained in a serge bag inserted in the shell and then filled.

Q. What is the use of the serge bag?

[1] The use of burster-bag discontinued. The powder now being packed in loose.

A. It reduces the chances of premature explosion of the shell due to friction.

Q. *How are shell stored on board ship?*

A. In the shell room, in their original boxes.

Q. *Give an approximate rule for the penetration of armor, at the muzzle and at 1000 yards.*

A. Two inches for every caliber at the muzzle, and one inch for every caliber at 1,000 yards. Thus an 8-inch gun will penetrate 16 inches of steel at the muzzle, and 8 inches at 1,000 yards.

Q. *What is the relative penetration of steel armor as compared with wrought iron?* [1]

A. Roughly speaking, with compound or steel armor it is about two-thirds that in wrought iron.

Q. *Give an approximate rule for the weight of the projectile.*

A. One-half the cube of the diameter in inches. Thus 10-inch gun, $10^3 = \frac{1000}{2} = 500$.

Q. *What ratio does the weight of the charge bear to the weight of the projectile?*

A. Approximately, one-half.

[1] *Two feet thickness of coal is equal to one inch of iron, roughly speaking.*

Experiments having demonstrated the superiority of projectiles fitted with a steel cap, the Department has decided to fit them to all service projectiles. The cap consists of a cylindrical piece of soft steel — half the caliber of projectile in diameter — bored out to a depth of $\frac{2}{3}$ its length to fit over the head of the ogival. A recess in the interior of the surface, .03 of an inch, contains a lubricating material. As to the true explanation of the action of the cap considered in conjunction with the theory of resistance of face-hardened armor, viz., the first effect of the striking projectile is to elastically dish the hard face. When the limit of strain is reached, this gives way, and the resistance then becomes largely local. The cap meeting the face at a high velocity, dishes or depresses the hard surface to its elastic limit. The projectile passing through, smoothed by the lubricant, meets the localized plate surface. The adoption of the cap has reduced the efficiency of face-hardened armor at least 15%.

FORMULA FOR THE PERFORATION OF FACE-HARDENED ARMOR, WITH TABLE.

$$V = \frac{a^{\frac{1}{2}} e^{\frac{3}{4}}}{p^{\frac{1}{2}}} \log.^{-1} 3.34512.$$

When V = striking velocity in foot-seconds;
a = caliber of gun in inches;
e = thickness of plate in inches;
p = weight of projectile in pounds.

Derived by Ensign CLELAND DAVIS, U. S. Navy, from experiments at the Naval Proving Ground, Indian Head, Md., under the direction of Captain W. T. Sampson, U. S. Navy, Chief of Bureau of Ordnance.

GUN.	PLATE.	VELOCITIES.	GUN.	PLATE.	VELOCITIES.
5″	4	1980	6″	5	1813
	5	2343		6	2078
	6	2683		7	2333
				8	2579
8″	8	1884	10″	10	1760
	9	2058		11	1891
	10	2227		12	2019
	11	2392		13	2143
				14	2266
				15	2386
12″	12	1696	13″	13	1648
	13	1801		14	1742
	14	1904		15	1834
	15	2005		16	1925
	16	2104		17	2015
	17	2202		18	2108

CHARGES.

Q. What is a charge?

A. The powder placed in the chamber of a gun to project the shell by its explosion.

Q. How are the charges for B. L. R. guns put up?

A. In serge cartridge bags as near as possible the shape of the powder chamber.

Q. What stiffens the bag?

A. Flat braid is secured around it at regular intervals.

Q. How is the powder arranged in the bags?

A. The grains are so stacked that the axial holes in the different layers are coincident.

Q. Are all the grains of a charge alike?

A. No; every charge has the center of the bottom layer of quick-burning powder

Q. In the larger calibers, 8-inch and larger, how are the charges put up?

A. In 8-inch and 10-inch, in two-cartridge bags; 12-inch and 13-inch are sometimes divided between four bags.

Q. How many layers of grains do the different charges contain?

A. The 5-inch full charge, 14 grains; the 6-inch, 19; the 8-inch, 37; the 10-inch, 61.[1]

Q. *How are the charges kept?*

A. In copper cylinders or tanks just large enough to contain the full cartridge.

Q. *How are the tanks opened?*

A. They have a removable air-tight and water-tight cover at one end, which fits over cylinder with a bayonet joint. A rubber gasket compressed between two plates makes the cylinder air tight.

Q. *How are the tanks lifted?*

A. By a handle at one end.

Q. *How is the powder stored in the magazine?*

A. In these tanks, arranged on shelves.

Q. *How is the tank marked?*

A. The caliber is marked in black, on white paper pasted on its side; and a two-inch white stripe of luminous paint extends half around the top of cap for the reduced charge, and entirely around for the full charge.

Q. *What is meant by a full or ordinary charge?*

A. It is a charge that will give a muzzle velocity of 2,000 foot-seconds to the service pro-

[1] 5-in., 20 and 38 layers; 6-in., 32; 8-in., 22; 10-in., 21.

jectile, with not more than 15 tons pressure in the chamber.

Q. What is a reduced charge?

A. It is a charge which will give 1,700 foot-seconds to the service projectile. The pressure from such a charge is about 10 tons per square inch.

Q. Referring to charge of gunpowder, define the terms, ignition, inflammation, and combustion.

A. *Ignition* is the setting on fire of a particular point of a grain or charge. *Inflammation* is the spreading of the fire from point to point on the surface of the grain, or from one granular surface to another throughout the charge. *Combustion* is the propagation of the fire into the interior of the charge or grain.

Q. Define the terms gravimetric density and absolute density as applied to gunpowder.

A. *Gravimetric density* is the weight of a standard volume of the powder not pressed together except by its own weight; i.e., it is its specific gravity in its natural form. *Absolute density* is the ratio of the weight of a given quantity of powder to the weight of an equal volume of water at the standard temperature; i.e., it is the specific gravity of solid powder.

Q. What is DENSITY *of* LOADING, *and how is it determined for any gun and charge?*

A. It is the ratio of the weight of the charge to the weight of water at its maximum density which will completely fill the volume in which the charge is fired.

FIXED AMMUNITION.

Q. What is fixed ammunition?

A. When the charge and projectile form a single piece it is called fixed ammunition.

Q. How is it made?

A. The charge is contained in a brass case, to the forward part of which is crimped the projectile, the two forming a single piece, which is loaded in one.

Q. What projectiles are used with fixed ammunition?

A. Common shell, armor-piercing shell, and case shot.

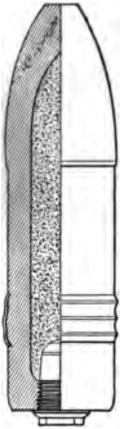
Q. Of what does case shot consist?

A. Of a thin sheet-brass case with a conical head and a gas-check bottom of soft metal to take the rifling. The case is fitted with hardened lead balls packed with sawdust.

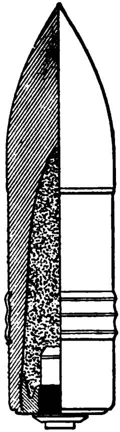
Plate XIV.

FIXED AMMUNITION,
HOTCHKISS TYPE.

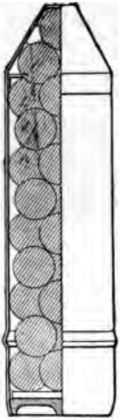
COMMON SHELL.



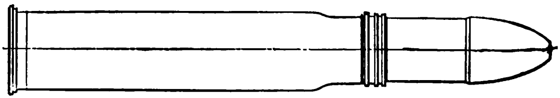
STEEL SHELL.



[illegible]



COMPLETE CARTRIDGE.



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Q. What is used in small-arm and Gatling ammunition?

A. Steel bullets, lead bullets, and lead bullets with steel casing.

Q. What guns use fixed ammunition?

A. All rapid-fire and machine guns.

Q. What is generally placed between the projectile and the charge in this ammunition?

A. A felt wad.

The approximate weights of bursting-charges are as follows:—

1-pounder and 37 mm. R. C.	250 grs.
47 mm. R. C.	600 grs.
3-pounder	900 grs.
6-pounder	1450 grs.
4-inch	2 to 2½ lbs.
5-inch	3 to 4½ lbs.
6-inch	3½ to 7 lbs.
8-inch	10 to 11 lbs.
10-inch	20 to 30 lbs.
12-inch	36 to 60 lbs.
13-inch	50 lbs. for forged.

CHAPTER VII.

EXPLOSIVES.

Q. What is an explosive?

A. A substance the constituents of which are in such a state of unstable equilibrium that a slight disturbing force will cause a chemical change, and the sudden production of a large volume of highly expanded gas.

Q. What, in general terms, are the ingredients of an explosive?

A. A combustible substance, and a substance to supply the oxygen to support combustion.

Q. What are the two general classes of explosives?

A. Explosive mixtures and explosive compounds.

Q. What is the difference between them?

A. In the explosive mixture the ingredients are mechanically mixed; in the compound they are united chemically.

Q. What are examples of each?

A. Gunpowder is an explosive mixture; gun-cotton, nitroglycerine, and fulminates are explosive compounds.

POWDER.

Q. What explosive is used in B. L. R. guns?

A. Gunpowder.

Q. What is gunpowder?

A. A mechanical mixture of saltpeter, charcoal, and sulphur.

Q. What is the form of powder used?

A. Pierced, prismatic, slow-burning powder.

Q. Why is it called pierced, prismatic?

A. Because each grain is made in the shape of a regular prism, and the center is perforated with a round hole.

Q. What is the advantage of this shape of grain?

A. In making up the charges the grains are in regular layers, with the holes coincident, which allows the gas to permeate the whole mass.

Q. Are the grains the same size for all calibers?

A. Two sizes smaller for 5″ and 6″ R. F. Guns, larger for all other guns. Dimensions: Diameter, l. 1″.26; s. .94″. Height, l. 1″.05; s. 87″. Hole, l. .32″; s. .17″. Grains to pound, l. 11 to 12; s. 32.

Q. In what proportion are the constituents mixed in this powder?

A. About the following: Saltpeter, 81%; charcoal, 15%; sulphur, 4%.

Q. What color is the grain?

A. Light brown.

Q. What is meant by slow-burning powder?

A. That in which the combustion occupies an appreciable time, such that the pressure due to explosion is exerted during the movement of the projectile from its seat to the muzzle of the gun.

Q. What is meant by priming-grains?

A. Grains of the same form, but black and quick burning.

Q. How are priming-grains placed in a charge?

A. At the bottom, in the center of last layer.

Q. Why is it placed here?

A. To insure quick ignition of the charge.

Q. To what test is this powder subjected?

A. It is required to give a muzzle velocity of 2,000 feet per second to the service projectile,

with a pressure not greater than 15 tons to the square inch in the powder chamber.[1]

Q. How are the charges regulated?

A. From the amount of powder required to give the above results with a given gun the weight of the charge is determined.

Q. What is the charge giving 2,000 f. s. called?

A. "Ordinary" or "full charge."

Q. In what other charges is this powder put up?

A. In "reduced" charges, giving a muzzle velocity of 1,700 feet per second, with a pressure of about 10 tons per square inch.

Q. After the powder is issued to the service, is it ever tested?

A. Yes; for each caliber on board ship appliances for testing are furnished.

Q. Of what do the appliances consist?

A. Of a spare mushroom with pressure-gauge ttachment.

Q. How is the test made?

A. The special mushroom is fitted, and the uge is screwed into its head; the gun is loaded th common or ordinary charge, and, when dy, fired.

[1] *Not to* have more than 1% residuum in bore.

Q. How does this register the pressure?

A. In the pressure gauge is fitted a copper cylinder, and the difference in the length before and after firing, referred to a standard, gives the pressure.

Q. What powder is used in fixed ammunition?

A. Quick-burning black powder of irregular grain.

Q. Is the size of the grain the same for all calibers?

A. No; they increase with the caliber, and the large calibers have specially formed grains.

Q. How is a vessel distinguished when she is receiving or discharging powder?

A. A red flag is hoisted at the foretruck.

Q. How is the powder served out to the ships?

A. In copper tanks just large enough to hold the charge.

Q. What care should be taken with the tanks?

A. They should be handled carefully so as not to indent or cut them.

Q. What kind of powder has lately been adopted for use in the navy?

A. Smokeless powder.

Q. What is smokeless powder?

A. An explosive compound, usually gun cotton, mixed with a restrainer of some kind to retard the rapidity of combustion.

Q. Why is it called smokeless?

A. Because, from the nature of the ingredients, there is no solid residue, the products of combustion being nearly all gaseous.

Q. What are the advantages of smokeless powder?

A. The volume of gases evolved from the same weight is much greater with smokeless powders than with black or brown powders; the pressure in the bore of the gun is more uniform, and therefore the force exerted on the projectile is greater. Also the absence of smoke on discharge is a distinct advantage.

Q. What are some of the physical properties of the smokeless powder issued to the service?

A. It is a hard, opaque substance, much lighter than ordinary powder, pale yellow in color, and is put up in the form of sticks resembling macaroni; i.e., having a cylindrical hole through the center about $\frac{5}{32}$ inch in diameter, the diameter of the stick being about $\frac{3}{8}$ inch.[1]

Q. What are usually termed high explosives, and for what are they used?

[1] And is also manufactured in flat strips.

A. Explosive compounds, such as gun cotton, nitro glycerine, and dynamite, in which the explosion is instantaneous, and consequently much more violent than gun powder; they are used for the charges of torpedoes, submarine mines, and for the bursting charges of special shell.

Q. What is the one most commonly used?

A. Gun cotton.

Q. What is gun cotton?

A. An explosive compound, made by the action of concentrated nitric acid on pulverized cotton fiber.

Q. How is it usually issued to ships?

A. In the solid state, and saturated with water.

Q. How is it ignited?

A. By a detonator; usually a small charge of dry gun cotton, which has been in turn ignited by a fulminate of mercury primer.

CHAPTER VIII.

FUSES AND PRIMERS.

Q. What are fuses used for?

A. To explode shell and shrapnel.

Q. What class of fuse is used with the new armament?

A. Combination time and percussion, and percussion.

Q. What is a time fuse?

A. It is a fuse that ignites at a prearranged time after the discharge of the gun.

Q. What combination fuse is used in B. L. R. guns?

A. The Boxer fuse.

Q. What is a percussion fuse?

A. It is a fuse that ignites by the impact of the projectile.

Q. What two classes of percussion fuses are used?

A. The nose and base.

Q. What is meant by a nose fuse?

A. A nose fuse is one that fits into the nose or point of the projectile, and the charge is exploded by flame through its base.

Q. What is meant by a base fuse?

A. It is a fuse that fits in the base of the projectile, and ignites the charge through its nose.

Q. What percussion nose fuses are used in the service?

A. The Schenkle, Percussion nose fuse,[1] and Hotchkiss.

Q. What base percussion fuses are used?

A. The Navy Percussion, Hotchkiss, Driggs-Shroeder.

THE BOXER.[2]

Q. What are the parts of the Boxer fuse?

A. Wooden stock (*S*), fuse composition (*E*), and igniter.

Q. Describe the wooden stock.

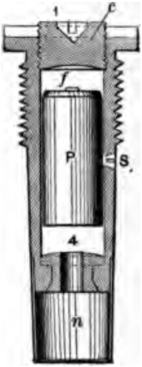
A. It is bored out in center to receive the paper-composition case, and has also two side channels, which are filled with mealed powder.

[1] This fuse has the same action as the Schenkle; has a *removable* safety cap, but no magazine.

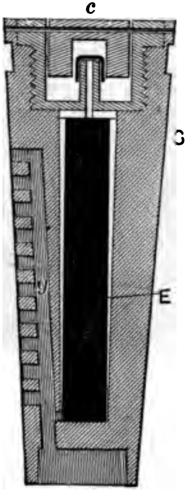
[2] See Plate XII.

Plate XV.

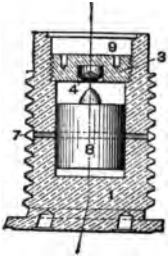
Schenkl
Percussion Fuse.

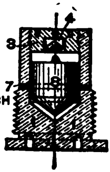


Boxer
Combination Fuse.



Base Percussion Fuses,





To face page 127.

Q. How is the fuse composition connected with the side channels?

A. By boring holes with a gimlet furnished with the fuse.

Q. How do you know where to bore the hole?

A. Strips of paper are pasted over the side channels, one of which has full seconds, and the other half seconds, marked on it.

Q. How many seconds is this graduated for?

A. Eleven seconds.

Q. Suppose the fuse is not bored at any mark, what then?

A. The flame would not enter the side channel until it reached its end, where there are communications to the side channels.

Q. Why could not the flame pass directly from the fuse composition?

A. Because the bottom of the fuse stock is solid, except where the side communications are bored.

Q. What is the igniter?

A. It is a small hollow brass cylinder, with a nipple on the inside of the lower part for a *percussion* cap; above this nipple is a brass *plunger* (*C*), held in place by a brittle wire.

Q. Explain the action of the fuse.

A. The shock of discharge breaks the wires, the plunger striking the cap; the explosion sets fire to the fuse, the flame passing down until it reaches hole from side channel, when it passes out, flashes down, and explodes the projectile.

Q. In what class of projectile is this fuse used?

A. In shrapnel.

THE SCHENKLE FUSE.[1]

Q. What is the Schenkle fuse?

A. It consists of a composition stock (*S*), containing a steel cylinder plunger (*P*); above this cylinder is a cap (*C*), which screws into the upper part of the fuse stock, and below is a magazine (*M*), filled with 75 grains of fine powder.

Q. What is the cap of the fuse?

A. It is a brass cap which screws into the upper end of the fuse stock, one side of which is plane, and the other side is hollowed out.

Q. Why is one side hollowed?

A. To guard against accidental explosion, the hollow side being kept next the plunger; should the plunger get loose, the cap could not explode.

[1] See Plate XII.

Q. What is the plunger?

A. It is a steel cylinder, filled with quick-burning powder, on the forward end of which is a nipple for an ordinary gun cap (*f*).

Q. How does the plunger fit in the fuse stock?

A. It fits loosely, and is held in the upper end of it by a small brass screw (*s*).

Q. What is the use of this screw?

A. It is a safe guard against premature explosion.

Q. Is it taken out before firing?

A. No; it is made of brittle material, and is left to be broken off by the shock of the discharge.

Q. What is the object of the copper cup fitted to base of fuse?

A. To insure the ignition of the bursting-charge, which, in the new projectile, is contained in a bag.

Q. How is the fuse gotten ready for use?

A. The fuse cap is unscrewed, reversed, groove side turned out, and screwed in again.

Q. What is the action of the fuse?

A. When the gun is discharged, the brass screw breaks, and liberates the plunger, which

recedes to bottom of stock; when the shell strikes, the plunger is driven forward, exploding the cap on its end, which ignites the powder in the cylinder, which, in turn, by means of the fine powder in copper cup, ignites the charge.

NAVY BASE FUSES.

Q. Of what do the Navy Base fuses consist?

A. Of a heavy gun-metal stock, brass plunger (*8*), brass plug (*3*), firing-cap (*4*), wire (*7*), and magazine (*9*).

Q. What is its action? [1]

A. The projection being set in motion, the inertia of the cylinder breaks the wire, and frees the plunger, which, upon the striking of the projectile, flies forward, the point striking the cap and exploding the shell.

THE HOTCHKISS NOSE FUSE.[2]

Q. What are the principal parts of this fuse?

A. The body (*S*), the plunger (*T*), the head (*s*), and the safety plug (*V*).

Q. Describe the body.

A. The body is cylindrical, of brass, with screw thread and a strong shoulder at the upper

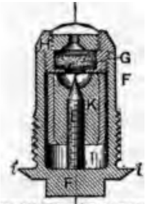
[1] See Plate XVI.
[2] *These are the* only fuses now being issued for shell—the *larger for 4-inch* and above, the other for minor caliber rapid-*fire shell.*

Plate XVI.

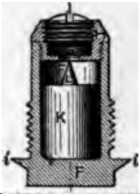
HOTCHKISS BASE PERCUSSION FUSE,

FOR STEEL SHELL.

FULL-SIZE.



POSITION OF PLUNGER BEFORE FIRING.

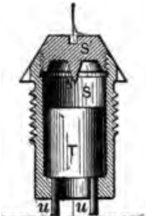


POSITION OF PLUNGER DURING FLIGHT.

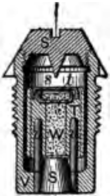
HOTCHKISS PERCUSSION FUSE,

FOR LAND SERVICE.

FULL SIZE.



POSITION OF PLUNGER DURING FLIGHT.



POSITION OF PLUNGER BEFORE FIRING.


SAFETY PLUG.

To face page 12

end for screwing in the shell; a chamber is positioned in this body, whose base has a conical hole bored for the safety plug.

Q. What is the plunger?

A. It is a hollow brass cylinder, with lead lining to give it weight, and containing a charge of powder, with fulminate cap over it.

Q. How is the plunger held in place?

A. By brass wires (*a*) inserted in lower part of plunger, with the ends leading through the safety-plug hole.

Q. What is the safety plug?

A. It is a lead stopper forced in the hole in the base of body, holding the brass wires.

Q. What is the head?

A. It is a gun-metal cap secured to the body by screw thread, and having a small steel striker in center of lower surface.

Q. Explain the action of the fuse.

A. On the discharge of the gun, the plunger is forced to the rear, driving the safety plug into the shell. The wires are now free; but they steady the plunger, and, on impact, the plunger drives *forward,* and the little magazine (t) is *exploded by contact* with the steel point.

Q. In what projectile is this fuse used?

A. In all Hotchkiss cast-iron shell for military use.

POINT-TIME FUSE FOR SHRAPNEL.

Q. What fuse is now being issued to replace the Boxer fuse?

A. Point-time fuse.

Q. What are the features of this fuse?

A. Metallic stock-plunger and wire, similar to percussion fuse, but arranged so that the shock of firing not only breaks the wire, but explodes the primer-cap, and ignites the central cavity of fuse through compressed powder ring. The fuses are graduated in thirds of seconds up to 15 seconds.

Q. How is the fuse set for a given time?

A. With fuse-cutter drill hole through the time train and the inner wall of the fuse into the central cavity, so that the flame escaping through this hole, shall ignite the time-train at the proper point.

SWEET'S DOUBLE-ACTION SAFETY FUSE.[1]

This fuse comprises a *time element* arranged *in the top* of the fuse body, a percussion element

1 See Plate XVII.

in the shank, and a *safety locking device* in the middle portion between the two elements.

The principal parts are: —

CAP (*C*) with waterproof washer.

ADJUSTING-RING (*R*) containing means for conveying the flame from the time plunger primer (*P*) to the time train (*T*); means for cutting train by hand, and spring pawls to prevent movement of adjusting-ring in flight.

BODY (*S*) containing the time and percussion elements, and appliance (*L*) for locking both plungers in a safe position.

ADJUSTMENTS.

When issued to the service, the *V* on adjusting-ring is over *S* on the index. In this position the fuse is safe, and may be roughly handled.

Before adjusting, the knurled ring must be freed by seizing the cutter string at the knot and pulling it over the cap, breaking the waterproof joint, being careful not to disturb the cutter in flame channel.

TIME. — To adjust for time, rotate the knurled adjusting-ring to the left until the *V* is over the time graduation desired (releasing locking device); *then pull* out the cutter, and the fuse is *set at the number* of seconds indicated. As the

gun is fired, the shearing-pin (X) breaks by t inertia of the plunger (P); the primer exploc on striking the firing point, the flame being c(veyed through the radial flame-holes in the t of the fuse-body and the channel in flame-c(veyer to the time-train, and augmented by t reinforcements at the base of firing-pin and ε nular flame-space.

The train burns to the explosion-hole oppos T on the index, igniting a column of quick-bu ing powder leading to the magazine, the explosi of which blows out the magazine-closing wash and fires the bursting-charge in the shell.

PERCUSSION. — To adjust for percussion, ı tate the adjusting-ring to the left until V poir to P on the index, releasing locking device; th pull out the cutter. The fuse is now set to ε plode the shell on impact only, owing to the en of train being protected by the lead plug, so th the flame for the time element cannot reach t time-train composition.

CAUTION. — In case the round is withdra from the gun, the adjusting-ring should be imn diately revolved until the pointer (V) is direct over S, when a click will be heard, indicati that the actuating-screw has dropped into t cam-slot, and that the spiral spring has rotat *the spindle* so as to lock the plungers.

If it is desired to return the cutter to its pla

revolve ring until pointer is over *P*, insert cutter, *tooth down*, as far as it will go, then move ring until pointer is over *S*.

THE HOTCHKISS BASE FUSE.[1]

Q. Is this fuse much used?

A. Yes; in all Hotchkiss steel shells, which are much oftener used than any other class.

Q. Of what does it consist?

A. Of three principal parts, — the body (*F*), the plunger (*K*), and the detonating-cap (*GH*).

Q. Describe the body.

A. It is of gun-metal, the lower exterior being threaded to screw into the base of the shell, and provided with a brass shoulder (*i*) beveled to a thin edge to form a gas check.

Q. What is the plunger?

A. It is a body of lead cast in a brass cylindrical case, containing a wire (*L*) roughened so as to hold in the lead.

Q. What is the position of this wire before firing?

A. The greater part extends below the plunger, just enough being above to keep it clear and *intact.*

[1] See Plate XVI.

Q. What is the detonating-cap?

A. It is a small hollow brass cap (*H*) containing the magazine (G), and screwed into the front end of the body.

Q. What is the action of the fuse when the gun is fired?

A. The powder pressure on the base of the fuse seals it gas tight, the plunger drives to the rear along the brass wire, the lead setting up and griping the wire firmly.

Q. What happens when the projectile strikes an object?

A. The plunger drives forward, exploding the cap and igniting the charge.

DRIGGS FUSE.

Q. How does this fuse differ from other base fuses?

A. It has a different plunger, which is not liberated when the gun is fired.

Q. What are the parts of this fuse?

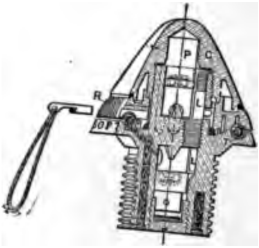
A. The body (*b*), plunger or pellet (*a*), spring (*c*), and detonating-cap (*e*).

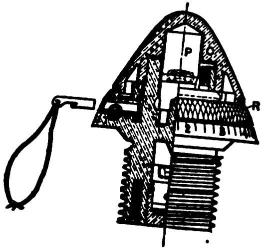
Q. How is the plunger made?

A. It is a cylindrical piece of gun metal, having a shallow groove cut on each side, and

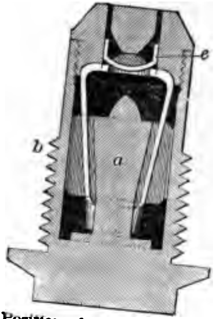
Plate XVII.

Sweet's Double acting Fuse.



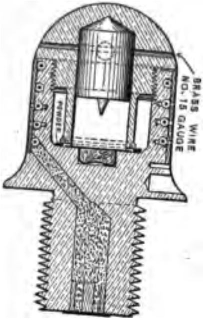


Driggs Percussion Fuse.



Position of Spring before and during flight.

Time Fuse.



To face page 134.

its rear end scored. In each groove is fitted an arm of the gun-metal spring, rigidly secured to the top of the body, the lug on each arm taking in the score, thus holding the plunger in place.

Q. How is the plunger freed?

A. The rotation given the projectile by the rifling wrenches the spring arms clear of the grooves, frees the lugs, and leaves the plunger free to explode the cap upon impact.

Q. What advantage is claimed for this fuse?

A. Its safety against premature explosion, the plunger being released only by a rotary motion.

PRIMERS.

Q. What are primers used for?

A. To ignite the charge of powder in the gun.

Q. How is this done?

A. The primer, containing a small charge of fine meal powder, is placed in the primer seat; and, when exploded, the flame passes through the axial vent, igniting the charge.

Q. How is the primer held in place in the primer seat?

A. By a spring lock screwing on to the end of mushroom stem carrying a wedge, which

revolves into place behind the primer head, firmly holding it.

Q. What primers are used in the service?

A. Vent-sealing primers, percussion, friction, and electric.

Q. Describe the percussion primer.

A. It consists of a brass case containing a small charge of fine meal powder, an explosive cap of fulminate, and an anvil. By the blow of the firing-pin upon the anvil, the cap is exploded, and the charge ignited.

Q. Is there any other form of percussion primer in use in the service?

A. Yes; there is one consisting of a steel case containing a charge of fine meal powder, a bullet of .22-inch caliber, and a cap.

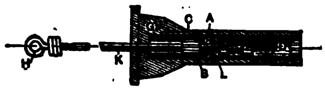
Q. Explain its action.

A. On the explosion of the cap the lead shot is fired into the charge, piercing the cartridge bag; the charge is then ignited by the burning of the powder.

Q. What is the new B. L. R. friction primer?

A. It consists of a metal stock (*G*), the outer end of which is filled with meal powder (*D*), and through the base of which passes the friction wire (*K*); the inner end, roughened and

coated with a fulminate mixture, fits into a small igniting-cylinder (*F*). In the bottom of the stock is fitted a gas check, consisting of a loose copper cylinder (*C*), shoulder disk (*L*), and gutta-percha and copper washers (*A* and *B*).



Q. What is the action of the primer?

A. The igniting-cylinder (*F*), resting on the shoulder disk (*L*), remains stationary, and by hauling on the loop (*H*) the wire (*K*) is drawn out, the friction exploding the fulminate, and the meal powder communicating the flame to the charge. The shoulder disk (*L*), pressing down on the cylinder (*C*), prevents the escape of gas around the edges, while the copper and gutta-percha washers prevent the escape of gas around the wire.

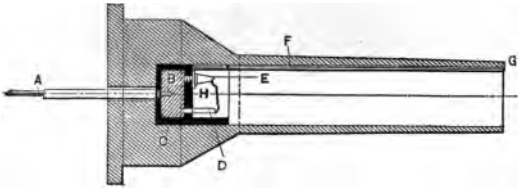
Q. Can this primer be used with the ordinary firing-attachment?

A. Yes; by substituting the electric for the percussion wedge.

Q. What is the new B. L. R. electric primer?

A. It consists of a brass case of the same *external* form as the friction and percussion

primers. It has a single insulated leading-wire (*A*) passing through the base, and soldered to the copper disk (*B*), at the bottom of the ebonite cup (*C*). A stud (*D*) projects from this disk. A second stud (*E*), insulated from the disk, is connected to the primer case by a copper tang (*F*), which is soldered at (*G*). The bridge (*H*), of very fine platinum-iridium alloy, is soldered to the studs (*D* and *E*). The bridge is surrounded by a wisp of dry gun cotton, and the rest of the case is filled with meal powder.



Q. What is the action of this primer?

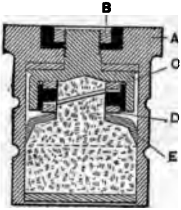
A. The current of electricity from the firing-battery passes through the leading-wire, the disk and stud (*D*); thence through the bridge and stud (*E*) to the primer case. The case being in contact with the gun, the return is through the gun and mount to the battery, the other pole of which is in contact with the gun mount. The passage of the current heats the bridge to a white heat, and ignites the gun cotton.

Q. Why are these primers called vent-sealing primers?

A. Because they are so arranged as to prevent all escape of gas to the rear.

Q. Describe the primer used with fixed ammunition in R. F. guns of 4 inch, 5 inch, and 6 inch calibers.

A. It consists of a brass case forced into the base of the cartridge case. An insulated cen-



tral contact post (*A*) projects through the base of the primer, and terminates in an insulated screwhead (*B*). The bridge is made between two copper rings (*C* and *D*) insulated from each other, one being in contact with the central contact post, the other with the primer case through a cup spring (*E*). The bridge is surrounded by a wisp of dry gun cotton, and the rest of case is filled with meal powder.

Q. Explain the action of this primer.

A. The current is carried to the bridge through an insulated firing-pin passing through the breech plug, and held firmly against the head (*B*) when breech is closed. The action is otherwise the same as with the B. L. R. primer described.

Q. What primer is used with fixed ammunition in smaller calibers?

A. The Hotchkiss primer.

Q. What is this primer?

A. It consists of two parts, a brass case shaped at the top to form an anvil, and a closed cap containing the fulminate.

Q. How are the reinforcement cups of the case made?

A. So that when the case is pressed up around its seat the joint is gas tight.

Q. How does the primer act?

A. The plunger, striking the cap, explodes the fulminate against the anvil, the flame passing through holes in bottom of case to the charge.

CHAPTER IX.

POINTING AND FIRING, AND MOTION OF PROJECTILES.

Q. What is the object in sighting a gun?

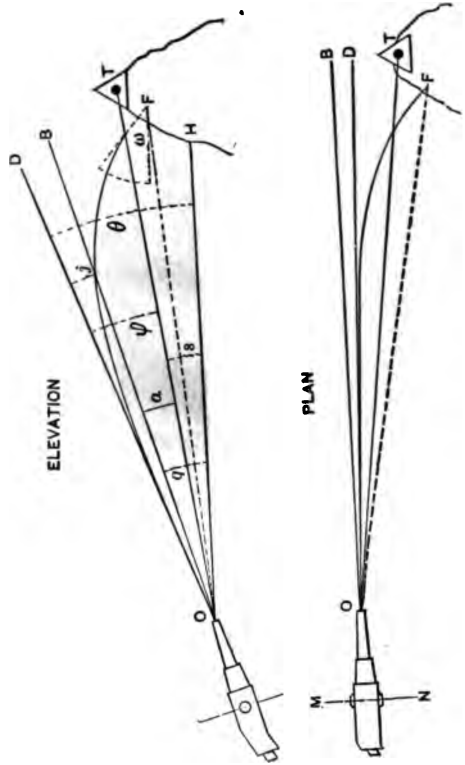
A. The object in sighting a gun is to point its axis in such direction that the projectile is likely to hit the target on firing. As the axis of the gun is not visible, recourse is had to sights on the exterior surface, to determine practically the position of the axis. The sights consist generally of two pieces, the situation of which with reference to the axis of the bore is known.

Q. What is the line of sight?

A. It is a straight line passing through the sights of the piece and the point aimed at, as *OT*.

Q. What is the plane of sight?

A. It is a vertical plane containing the line *of sight.*


ELEVATION
D
B
T
F
H
O
PLAN
B
D
T
F
O
M
N

Q. What is the angle of sight?

A. It is the angle which the line of sight makes with the horizontal plane, as ς.

Q. What is the line of fire?

A. It is the axis of the bore, prolonged in the direction of the muzzle, as OF; and the *plane of fire* is a vertical plane containing the line of fire.

Q. What is the angle of fire?

A. It is the angle included between the line of fire and the horizon.

Q. What is the angle of departure?

A. It is the angle which the line of departure makes with the horizontal plane, as θ.

Q. What is the angle of projection?

A. It is the angle between the line of departure and the line of sight, as ϕ.

Q. What is the quadrant angle?

A. It is the angle which the axis of the piece, when aimed, makes with the horizontal plane, as $\mathfrak{P}$. It is termed the *angle of elevation or depression*, according as the axis is pointed above or below the horizontal plane.

Q. What is the angle of fall?

A. It is the angle which a tangent to the trajectory, at the first point of impact makes with the horizontal plane, as ω.

Q. What is the line of departure?

A. It is the line in which the projectile is moving when it leaves the gun; it is, therefore, the tangent at the muzzle of the gun to the curve described by the projectile, as *OD*.

Q. What is the axis of a piece?

A. The central line of the bore.

Q. What is the angle of elevation?

A. It is the angle included between the line of sight and the axis of the bore, measured in a plane perpendicular to the trunnion axis.

Q. What is the angle of jump?

A. It is the vertical angle which the axis of the bore describes in the act of firing, as j. It is due partly to the straining effect of the gun on its carriage and on the gun platform, and partly to slackness in the mounting. It is positive when the muzzle rises in firing, as in the figure.

Q. What is the danger space?

A. It is the horizontal distance measured *backward* from the first point of impact,—in *which the* trajectory would catch any vertical

target; the flatter the trajectory, the greater the danger space.

Q. What is the angle of incidence?

A. It is the angle which a tangent to the trajectory at the point of impact makes with the surface struck.

Q. What is the axis of the trunnions?

A. A line passing through the center of the trunnions.

Q. What is the point blank?

A. It is the distance at which the projectile strikes the horizontal plane on which the carriage rests, the axis of the piece being horizontal.

Q. What is extreme range?

A. It is the distance to the point at which the projectile is brought to a state of rest.

Q. What are the forces acting on a projectile fired from a cannon?

A. The projectile force, force of gravity, resistance of the air, and the friction against the surface of the bore.

Q. What is the projectile force?

A. It is that force produced by the combustion of the powder in the piece. This will vary for similar charges, depending on the quality of

the powder, the method of loading, the movement of the projectile in the bore, and temperature of the piece.

Q. What is the effect of the force of gravity?

A. It tends to draw the projectile downward, toward the center of the earth.

Q. What is the effect of the resistance of the air?

A. It resists the action of the projectile force, diminishes the range, and causes the projectile to deviate from its original direction.

Q. What is the effect of friction against the bore?

A. It retards the projectile, thus varying the range and velocity; increases the probability of injuring the piece or projectiles, and causes deviation of the projectile from its original direction.

Q. How is sighting affected by the different forces acting on the projectile?

A. Owing to the action of the force of gravity, the piece must be pointed to some point above the target; and owing to drift in rifle projectiles, as modified by the force of the wind, the axis must be pointed to the right or left of the target, depending on the direction of the rifle motion. The curvature of the trajectory

is also modified by the intensity of the projectile force, and the resistances offered to the motion of the projectile.

Q. What is the trajectory?

A. It is the curve, resulting from the action of these forces, described by the projectile in passing from the muzzle of the piece to the first point of impact.

Q. What is the range?

A. It is the distance from the piece to the first point of impact of the projectile.

Q. What is lateral deviation?

A. It is the perpendicular distance of the point of impact of the projectile, right or left of the plane of sight.

Q. What is windage?

A. The difference between the diameters of the gun and projectile.

Q. What are the principal causes of the deviation of projectiles?

A. Rotation and resistance of the air.

Q. What is the cause of deviation of an oblong projectile?

A. An oblong projectile, moving in the air, *is acted on by two* rotary forces, one of which *gives it rotation* about its longer axis, and an-

other due to the resistance of the air, which, owing to the way it acts, tends to rotate the projectile about its shorter axis. While it does not yield fully to either of these forces, its point will move with a slow motion either to the right or left of its original direction, depending on the relative direction of the two forces.

Q. What is drift?

A. The constant deflection of the projectile from the plane of departure due to the rotation imparted by the rifling of the piece.

The rifling being usually right handed, the deflection is compensated for by placing the rear sight at an angle to the left. This correction is the angle of set.

Q. What is muzzle velocity?

A. The velocity of the projectile on leaving the piece in feet per second.

Q. What is remaining velocity?

A. The velocity at any point of the trajectory.

Q. What is final velocity?

A. That at the point of impact.

Q. How is initial or muzzle velocity determined?

A. By an electro-ballistic machine. Two targets, each carrying a number of tightly

stretcheu copper wires, are set up, the first at a given distance from the muzzle of the gun, and the second at a known distance from the first. Each is electrically connected with the ballistic machine, which records the instant the current is broken at each target by the passage of the projectile through the network of wires. Having a scale of time, the interval between the breaks thus registered is known, and, being corrected for errors, gives the time of passage between targets, from which the initial velocity is easily determined.

Q. What precaution should always be taken before firing?

A. See that the sights and sliding-leaf are properly set.

Q. In pointing a gun, which should be given first, the lateral train or the elevation?

A. When possible, the lateral train, because the jarring of the gun in moving it is apt to alter the elevation.

Q. How is the gun trained if the ship is moving rapidly?

A. It is better to train a little beyond the object, and watch for the exact moment for firing.

Q. Suppose the object be a vessel under way?

A. Then train a little ahead of her, and fire just before she comes into the line of sight.

Q. If the vessel is at sea, what is the best time to fire?

A. At the end of the roll, if possible rolling toward the target, as at that point the angular velocity of roll is zero, and the recoil is less violent.

Q. How is allowance made for the wind in firing?

A. If the sight is fitted with the sliding-leaf it can be set; if not, the gun must be pointed to windward of the object.

Q. How is the sliding-leaf moved with reference to the wind?

A. It is moved toward the wind.

Q. How is it moved with reference to a moving target?

A. Moved toward the direction in which the target is moving.

Q. How moved for ship going ahead?

A. Moved aft.

Q. What is a good rule for setting the leaf?

A. Move in the direction the projectile is to *be sent.*

Q. What is firing at will?

A. Firing the guns independently of each other.

Q. What is firing in succession?

A. Firing the guns one after the other in regular order.

Q. Does the firing commence aft or forward?

A. It commences forward, unless the wind be forward of the beam; then it is better to commence aft, so that the smoke will not interfere with pointing the guns.

Q. What is ricochet firing?

A. Firing so that the projectile will graze the water or ground before striking the object.

Q. Why can it not be used with rifle projectiles?

A. Because, as they have a rapid rotary motion, the least touch is apt to deflect them from their course.

Q. What is direct firing?

A. Firing immediately at an object.

Q. What is curved firing?

A. Giving the piece a high elevation, so that the projectile will pass over an obstacle, and strike an object behind it.

Q. What is meant by front, oblique, and enfilade fire?

A. Fire when the line of fire is respectively perpendicular, inclined, and parallel, or nearly so, to the front of the object fired at. With reverse fire the object is fired at from the rear.

Q. What is plunging fire?

A. The fire of guns more elevated than the object fired at.

Q. With a ship's battery, what is concentrated firing?

A. When the fire of all the guns is directed to the same point, and they are all discharged at the same time.

Q. By what is the fire of the battery regulated?

A. By one gun, usually the center one, which is called the directing-gun.

Q. How are the guns trained so as to concentrate their fire on one point?

A. By means of marks on the outer training-circle.

Q. If the ship is heeling over, how is the gun laid level?

A. By first laying it to the level mark on the elevator, and then elevating it as many degrees as the indicator shows the ship to be heeling.

Q. What is broadside firing?

A. Firing with all the guns pointing in the same direction, so that their fire is parallel, and firing them all together.

Q. How does it differ from concentrated firing in manner of execution?

A. It is the same, except that, as all the guns are parallel, there is no directing-gun.

Q. How are all the guns fired at one time?

A. By a contact lever in the conning-tower, which is connected electrically to the firing-circuit of each gun.

Q. In concentrated and broadside firing, it is necessary to have the object in sight?

A. No; the object may be in sight or obscured so far as the gun captain is concerned, but it must be visible from some part of the vessel.

Q. What are the principal causes of inaccuracy in firing?

A. First: Want of accuracy in the gun and mounting.

Second: Want of uniformity of ammunition.

Third: Errors in sighting.

Fourth: External causes, such as wind.

Fifth: Inaccuracies due to unknown range.

CHAPTER X.

DRILLS AND EXERCISES.

Drill of 6-inch and 8-inch B. L. R. on Fixed-Pivot Carriage.

For a gun and its opposite on the same deck, the arc of fire of each being practically limited to one side of the keel.[1]

(CREW OF 12 MEN.)

MUSTER AND INSPECTION.

Q. At the order "Muster the crew," what is done?

A. If at the gun, Nos. 1 and 2 face about, and No. 1 musters the crew by numbers.

Q. How do the numbers answer?

A. 3. 1st sponger and elevator, 2d rifleman.
4. 2d sponger and elevator, boarder.
5. 1st loader, boarder.

[1] *The distribution* of the crew and places at mustering, *also for 8-inch* B. L. R. with arc of fire the same on both *sides of keel,* and 6-inch B. L. R. shifting-pivot carriage.

6. 2d loader, 1st rifleman.

7. 1st trainer and pumpman, 1st rifleman.

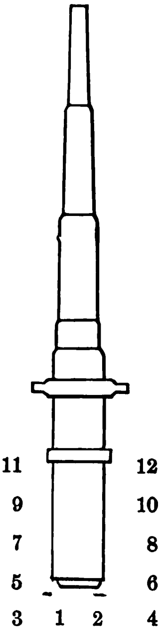
8. 2d trainer and fireman, 2d rifleman.

9. 1st shellman, port guard.

10. 2d shellman, port guard.

11. 1st powderman, 2d rifleman.

12. 2d powderman, 1st rifleman.[1]



Places of Crew at Mustering.

Q. What is No. 1?

A. 1st captain, boarder.

Q. What is No. 2?

A. 2d captain, 2d rifleman.

Q. Are the men ever exercised at the different stations?

A. Yes; at the order "Change stations, march," they file one number to the left, No. 1 becoming No. 12, etc.

Q. Who are boarders?

[1] We have intentionally omitted drills, only retaining one each of the B. L. R. and R. F., which are inserted simply as a method of making the members conversant with their duties.

A. Nos. 1, 4, and 5; arms, cutlass, and revolver.

Q. *Who are 1st riflemen?*

A. Nos. 6, 7, and 12.

Q. *Who are 2d riflemen?*

A. Nos. 2, 3, 8, 11.

Q. *Who are port guards?*

A. Nos. 9 and 10; arms, rifles.

Q. *What is done at the order "Form for inspection"?*

A. Nos. 1 and 2 place themselves promptly in front of the men on their respective sides.

Q. *What is done at the order "March"?*

A. The numbers on the right, column right and form on the right of the breech, facing in board, and those on the left form on the same line on the left of the breech.

Q. *At the order "Draw swords," what is done?*

A. At the order "Draw," grasp the sword with the right hand and draw it six inches; at the order "swords," free it from scabbard and carry to the hollow of shoulder.

Q. *When the inspecting-officer arrives, what order is given by the division officer?*

A. "Division, salute!"

Q. What is done at this order?

A. All arms are brought to a "present": those men having no arms raise the right hand to the cap, making a salute.

Q. At the order "Carry arms," what is done?

A. The hands are brought down, and the arms brought to the position of "order."

EXERCISE. — "SILENCE!"

Q. What is done at the order "Silence"?

A. The crew face the gun, and stand at attention, observing strict silence.

"CAST LOOSE AND PROVIDE!"

Q. How is the order "Cast loose and provide!" executed?

A. With broadside guns the first part, or odd numbers, casts loose the starboard gun, and the second part, or even numbers, the port gun. With the even-numbered crews the reverse will obtain.

Q. What are the duties of No. 1 at this order?

A. Commands; sees that the appliances for opening the breech are in place; opens the breech for the removal of the tompion; inspects

the gas check; prepares lock for use; places rear sights; removes sight covers; sees priming-wire and boring-bit in place; equips himself with primers; closes the breech after the bore has been sponged; reports to the division officer when all is ready.

Q. How does No. 1 prepare the lock for use?

A. He takes it from its case, and screws it on the mushroom stem.

Q. What is meant by placing the rear sight?

A. Shipping the sight which is usually kept in a sight rack near the gun.

Q. What are the appliances for opening the breech?

A. Wooden mallet, and section of gas pipe or special crank.

Q. What is a tompion?

A. It is a wooden stopper fitted in the muzzle of the gun to keep out water and dampness.

Q. How is it removed?

A. From the breech by a steel wire laniard.

Q. How does No. 1 inspect the gas check?

A. Sees pad smooth and in place, and that it *is held* at the proper tension by the nuts on the *mushroom* stem.

Q. What does No. 2 do?

A. He has the same duties as No. 1 on the opposite side, and reports to No. 1 when all is ready. At night attaches battle lantern if used.

Q. What are the duties of Nos. 3 and 4?

A. They see elevator gear free; cast off all lashings, and place them amidships out of the way; open ports; see loading-tray in place; remove tompion and muzzle bag.

Q. Where is the loading-tray kept?

A. In a bracket near the gun.

Q. What is the muzzle bag?

A. It is a painted tarpaulin bag fitted over the muzzle of the gun to protect it.

Q. Where are rammer and sponges kept?

A. In a hook rack over or near the gun.

Q. What are the duties of Nos. 5 and 6?

A. They assist in casting loose; place short rammer and chamber bristle sponge on the left and rear of the gun, heads toward the muzzle; remove the sponge cap; with the division-bore bristle sponge, sponge the entire bore of the gun; assist 7 and 8 in providing gun tub, and provide deck bucket each.

Q. How can the chamber bristle sponge be distinguished from the division-bore bristle sponge?

A. The handle of the division-bore is much the longer, and in two sections.

Q. What are the duties of No. 7?

A. Assists in casting loose and in opening ports; provides marine sponge and its bucket filled with fresh water; sees training-gear clear and ready for use; trains gun abeam.

Q. What is the marine sponge?

A. An ordinary sea sponge.

Q. Where is it kept?

A. In the supply box.

Q. What are the duties of No. 8?

A. The same as No. 7; sees division tub filled with fresh water.

Q. Where is the division tub kept?

A. Near the guns.

Q. What does No. 9 do?

A. Provides three cutlasses, three revolvers, and three boarders' belts, a fuse cutter, and shell tongs; assists in casting loose; provides a swab, placing it under the sponge head; goes for shell.

Q. Where are the cutlasses found?

A. In racks near the gun.

Q. Where are the revolvers kept?

A. In the armory.

Q. Where does No. 9 get the boarders' belts and fuse cutter?

A. From the supply box.

Q. Where are the shell tongs kept?

A. On hooks near the gun.

Q. What does No. 10 do?

A. Provides a swab, placing it under the sponge head; provides spare tackle; assists in casting loose; goes for shell.

Q. Where are the swabs kept?

A. Also on the rear transom.

Q. Where do Nos. 9 and 10 get the shells?

A. From shell hatch on the same deck as the gun.

Q. What does No. 11 do?

A. Provides five rifles, bayonets, and belts; goes for powder.

Q. What does No. 12 do?

A. Provides four rifles, bayonets, and belts; goes for powder.

Q. Where are the rifles kept?

A. In the armory or in racks near the gun.

Q. When they are kept in racks near the gun, who provides them?

A. Each number provides his own rifle.

Q. Where do Nos. 11 and 12 get the powder?

A. From the powder hoist, on the same deck as the gun.

Q. What is done after each number has performed his individual duty?

A. He assists generally in casting loose, and puts on his belt.

Q. Where are the belts kept?

A. In the division chest, and served out, becketed together, by the gunner's mate.

Q. What is done as soon as the guns are cast loose?

A. The whole crew assists in placing mantlets, if provided.

Q. What are mantlets?

A. They are steel screens placed between the guns.

Q. When each part has finished casting loose, what is done?

A. The men go to the same gun, and take the same positions that they occupied when the order "Silence" was given.

Q. Are the men exercised with belts and arms on?

A. After inspection, the order is given, "Lay aside belts and arms," when all, except Nos. 1 and 2, take off their belts, and place them amidships out of the way, and return their arms to portable racks amidships.

Q. What are the duties of the gunner's mate?

A. He provides division-bore bristle sponge, and sandbag; issues belts, locks, sights, fuse cutter, and tourniquets, and sees divisional accessories in place.

Q. What are the divisional accessories?

A. Wooden maul, drill brace, set of wrenches for mushroom nuts, vent cleaner, vent-sealing primers, spare lockstrings, twist vent drill, wrench for breech mechanism, tourniquets, and hand primer extractor.

Q. What is the division-bore bristle sponge?

A. It is an ordinary bristle sponge with sectional handle.

Q. What is a tourniquet?

A. It is a strap or bandage so arranged that when put on a man's arm or leg it stops the flow of blood from a wound.

Q. What is the wooden maul used for?

A. To tap the lever, and start the breech plug.

Q. What is the vent cleaner?

A. It is a steel wire with ring handle.

Q. When are the vent-twist and drill brace used?

A. They are very rarely used, as accidents with the new primers are of rare occurrence.

Q. What is done at the order "Man the starboard (or port) guns"?

A. All except Nos. 3 and 4 go on the jump to the guns designated.

Q. What do Nos. 3 and 4 do?

A. They see everything in place and secure, and then cross over.

"SPONGE!"

Q. What is designated at the order "Sponge"?

A. The charge, projectile, and fuse.

Q. How is the charge designated?

A. As "full" or "reduced."

Q. How is the projectile designated?

A. As armor-piercing or common shell, or shrapnel.

Q. How is the fuse designated?

A. As so many seconds, such as 5-second fuse, etc.

Q. What does No. 1 do at the order "Sponge"?

A. He gathers up lock laniard, and thrusts it in his belt; superintends adjustment of fuse.

Q. Why has not No. 1 more to do?

A. His duty is to fire the gun, and he must keep himself constantly informed of the position and direction of movement of the target.

Q. What does No. 2 do?

A. With his left hand unhooks the laniard from the lock, and drops it; opens the breech; steps to the right, extracts the old primer, and puts it in his belt pouch; wipes off threads of plug with an oiled rag when necessary; turns mushroom so that the lock is right side up; examines gas check and the whole breech mechanism, and reports to No. 1 if anything is not in good order.

Q. Does No. 2 ever have trouble in unlocking the breech?

A. Yes; the plug is sometimes jammed.

Q. To what is this due?

A. To improper adjustment of mushroom an gas check upon the breech plug, or to the stick ing of the rear disk of the gas check, owing t the swelling in firing.

Q. What does No. 3 do at the order "Sponge"

A. Slightly depresses the breech.

Q. What does No. 4 do?

A. Places the bucket of water and marin sponge under the breech of the gun.

Q. What other duties has No. 4?

A. With the marine sponge well saturate with water, wipes the scale from the mushroo face and gas check, and returns sponge t bucket.

Q. What does No. 5 do?

A. Enters short bristle sponge, well wette into the chamber to the mark on the handl and, assisted by No. 6 if necessary, turns i withdraws it, and places it on deck, its hea resting on its swab; then picks up rammer.

Q. Why is the rammer handle marked?

A. To show when the shell is home.

Q. What other duties has No. 3?

A. Wipes residuum from the screw-box wit the marine sponge or a piece of waste; wipe

off the gas-check seat, picks up the loading-tray, inserts it in its seat, and steps one pace to the left of the gun.

Q. What do Nos. 9 and 10 do?

A. Bring the projectile to the left and rear of the gun, and adjust the fuse, which No. 1 inspects.

Q. How does No. 1 adjust the fuse?

A. If it is the Schenkl, he reverses the cap; if the Boxer, he bores the hole corresponding to the time given.

Q. What do Nos. 11 and 12 do?

A. Bring up the powder in its tank.

"LOAD!"

Q. What is done at this order?

A. Nos. 9 and 10 bring up the projectile on its bearer, and place it on the loading-tray.

No. 5 steps to the rear of Nos. 9 and 10, with the short rammer in hand, and pushes the projectile home smartly, as shown by the mark on the staff, assisted by No. 6 if necessary, and lays rammer down on deck.

Nos. 9 and 10 retire, and go for another projectile.

No. 11 holds the powder tank, No. 12 removes

the cover, hands it to No. 11, and taking out the cartridge, places it on the loading-tray, the tie end in, and pushes it home by hand.

In case the powder charge is in two sections, the one first entered must be pushed home by No. 5 with the rammer, which in this case will be held vertical after pushing the shell home until this is done. The rear section of the charge is pushed to its place by hand. Nos. 11 and 12 recap and return the powder tank, and await a fresh charge.

No. 3 removes loading-tray from screw-box; puts it in place; takes a marine sponge from gun tub; wipes off gas-check seat and screw-box again, and returns the sponge to the tub, which is removed by Nos. 4 and 6, if necessary.

No. 2 now closes the breech.

No. 1 inserts a primer; hooks the lock laniard first, and then full cocks the lock.

"POINT!"

Q. What is given by the division officer at the order "Point"?

A. The distance and the direction of the target and the correction for the sliding-leaf.

Q. How is the distance given?

A. In yards.

Q. How is tne correction for sliding-leaf given?

A. In knots and tenths of knots.

Q. Who sights the gun?

A. No. 1.

Q. Who sets the sight?

A. No. 2. (If the left sight is used, No. 3.)

Q. What numbers train the gun?

A. Nos. 7 and 8, assisted by Nos. 5 and 6.

Q. Who attend the elevating-gear?

A. Nos. 3 and 4.

Q. In pointing the gun, what orders are given by No. 1?

A. "Right," "Left," "Raise," "Lower," "Well."

Q. What do these orders refer to?

A. To the breech.

Q. Is the word "Ready" given?

A. No; it is intentionally omitted, because the elevating- and training-gear are so arranged that the elevating- and training-numbers are not in the way of the recoil.

Q. Does No. 1 wait for the order to fire?

A. In firing independently, as soon as the sights are on the target, No. 1, without waiting, fires, and watches the fall of the shot.

Q. What orders are given by the division or supervising officer?

A. "Commence firing;" or, "In succession, beginning forward or aft, commence firing."

Q. After the gun is fired, what is done?

A. The crew take their stations for sponging.

"SECURE!"

Q. What is done at the order "Secure"?

A The numbers return what they provided, and secure what they cast loose.

"MAN ALL THE GUNS!"

Q. What is done at this order?

A. From each pair of guns having but a single crew, the starboard watch will man and work the starboard gun; the port watch, the port gun.

Q. Who provides the guns with ammunition?

A. The shellmen and powdermen.

1ST PART.	POSITIONS AT GUN.	DUTIES.	2D PART.
1	On left and in rear of gun.	Of 1.	2
3	On right of breech.	Of 2 and 4.	4
5	*On left* of breech.	Of 3.	6
7	*On left of* breech.	Own duty and that of 5	8

o-*inch R. F. guns?*

A. For a gun and its opposite on the same deck, each of which is on a fixed pivot, and has its arc of fire practically limited to one side of the keel.

Distribution of the Crew. (8 Men.)

Titles of Men on Left Side of Gun.		Gun Nos.		Titles of Men on Right Side of Gun.		Arms. Cutlasses.	Arms. Revolvers.	Arms. Rifles.
1st Captain . .	Boarder . . .	1	..	. . . .	. . . .	1	1	
			2	2d Captain .	1st Rifleman .	..	..	1
1st Loader . .	2d Rifleman .	3	..	. . . .	. . . .	..	..	1
			4	2d Loader .	Boarder . . .	1	1	
Shellman . . .	Port Guard . . Pumpman.	5	..	. . . .	. . . .	..	..	1
			6	Shellman . .	Port Guard . . Fireman.	..	..	1
Shellman . . .	2d Rifleman .	7	..	. . . .	. . . .	..	..	1
			8	Shellman . .	1st Rifleman .	..	..	1

Q. What are the titles and distribution of the crew of a pair of 8-inch B. L. R. mounted in barbette or turret?

Distribution of the Crew. (12 Men, 6 to each Gun.)

Gun Nos.	Titles.	Stations.
1	Captain .	At right-hand gun, commands; at left-hand gun in left hood.
2	Plugman,	At plug crank.
3	Loader .	Rear of gun (outboard side).
4	Sponger .	Rear of 3 (outboard side).
5	Liftman .	At lift motor and lift.
6	Shellman	At hand ammunition hoist.

For the purpose of muster or inspection the crews will be drawn up in line, outside and near the turret, facing inboard, No. 1 on the right.

Q. What are the titles and distribution of the crew of a pair of 10-inch, 12-inch, or 13-inch B. L. R. mounted in barbette or turret?

NOTE. — An officer is stationed on the seat in hood as gun pointer, because it is supposed that, as a rule, one can be selected who has good eyesight, is well instructed. is accustomed to the firing of guns, and has the qualities of coolness and discretion necessary to such a position, for the gun pointer of a powerful turret really has one of the most responsible posts in a ship. If it be the opinion of the Captain that one of the enlisted men possesses the necessary qualities in greater perfection than any of the available officers, he will place this individual as gun pointer.

Distribution of the Crew. (12 Men, 6 to each Gun.)

Gun Nos.	Titles.	Stations.	Arms.
1	Captain	Hydraulic rammer . .	Revolver.
2	1st Plugman and Sponger	Rear end of plug platform	Revolver.
3	2d Plugman and Sponger	Front end of plug platform	Revolver.
4	Liftman	At lift lever	Revolver.
5	Return Leverman,	At return lever . . .	Revolver.
6	Trainer	At training lever . .	Revolver.

No. 6 of the left gun of the pair is stationed on the platform between the guns, where he sets the sights. For the purpose of muster or inspection the crew will be drawn up in line, outside and near the turret, facing inboard, No. 1 on the right.

Drill of the 3-pr. and 6-pr. Hotchkiss.
(Crew of 4 Men.)

Nos.	Stations.	Revolvers.
1	1st Captain	1
2	2d Captain	1
3	1st Loader and Shellman	\
4	*2d Loader* and Shellman.	\

Q. How is the gun crew selected?

A. They should all be well-trained rifle shots.

Q. What are the stations for mustering for guns mounted on deck?

A. In line directly in rear of the gun, facing inboard, No. 1 on the right.

Q. What are the stations of crews for guns mounted aloft?

A. On deck, abreast the mast, facing outboard, No. 1 on the right.

Q. What are the words of command?

A. 1. "Silence!" "Cast loose and provide!"

2. "Load!"
3. "Point!"
4. "Commence firing!"
5. "Cease firing!"
6. "Unload!"
7. "Secure!"

Q. What is done at the order "Silence"?

A. The crew come to attention, and stand by for the order "Cast loose and provide."

Q. What does No. 1 do at this order?

A. Commands; removes gun cover; casts *adrift* gun-lashings; places sight cover clear; *ships* gunstock; removes drill hook, and hooks

up spring; tests the breech mechanism; examines bore; sees in place gear and implements for the service of the gun; when all is ready, reports to officer in charge, and takes station in rear of and facing gun.

Q. What does he do if gun is mounted aloft?

A. He first goes aloft, and sends down tackle for hoisting up ammunition and other articles for the service of the gun.

Q. How is the stock shipped?

A. The T heads of the stock and stop bolts are turned fore and aft, the stock is fitted on stock pin, and the stock and stop bolts turned a quarter turn.

Q. What is the drill hook?

A. It is a device to relieve the mechanism from strain when snapping the gun at drill.

Q. How is it fitted?

A. Its two ends hook over the stirrup, and the end of the mainspring rests on its loop.

Q. How does No. 1 test the breech mechanism?

A. He opens and closes the breech, and sees it in working order.

Q. What are the duties of No. 2?

A. Provides and examines the reserve box containing the accessories and spare parts; pro-

vides four revolvers and belts, and puts revolve in rack near the gun; provides clean swa adjusts drill apron; sees trunnion and piv clamps in working order; sees carriage in wor ing order; takes his station at right side breech and facing it.

Q. If the gun is mounted aloft, what does 1 2 do?

A. He goes aloft and receives articles whipp up.

Q. What does a reserve box contain?

A. Accessories, — sponge brushes, cleanin brush, oil-can, screwdriver (special), dismou ing-pin, hand extractor, and drill hook (exce for 1-pounder); spare parts, — stop bolt, ha mer, firing-points for hammer, mainspring, se sear springs, and extractor.

Q. When is the drill apron used?

A. Only when the exercise is with drill c tridges.

Q. What is the dismounting-pin?

A. It is an S-shaped rod for backing out bol

Q. What are the duties of No. 3?

A. Assisted by No. 4, brings ammuniti from hatchway, and places it in rear of g

amidships; provides wet swab; takes station at left side of breech and facing it.

Q. How is the ammunition furnished?

A. In boxes containing 60 cartridges for 1-pounder, 16 for 3-pounder, and 11 for 6-pounder.

Q. What are the duties of No. 4?

A. He assists in bringing ammunition from the hatchway; provides a bucket of water; takes his station in rear of gun, alongside ammunition.

Q. If the gun is mounted aloft, what are the duties of Nos. 3 and 4?

A. They whip up articles for the service of the gun, and secure net to the top, under lubber's hole.

Q. What is done as soon as each number performs his duty?

A. He puts on his belt with revolver.

Q. Are belts and arms worn during the drill?

A. No; after the division officer inspects he orders, "Lay aside belts and arms," when they are placed clear of the gun.

"LOAD!"

Q. What are the duties of No. 1 at the order *"Load"?*

A. Places shoulder to the stock; seizes the directing-handle with left hand, and as soon as gun is unclamped lays it with muzzle outboard; plants feet firmly to resist motion of the ship.

Q. What are the duties of No. 2?

A. Assists No. 1; unclamps pivot and trunnion as soon as No. 1 has his shoulder to the stock; grasps and throws back smartly breech-block lever, opening the breech; after No. 3 has inserted cartridge, closes breech by smart movement of breech-block lever; performs duty of No. 3 while latter is providing a fresh box of ammunition.

Q. What are the duties of Nos. 3 and 4?

A. No. 4 passes cartridge to No. 3, who takes it, and, as soon as the breech is open, points the shell fairly, and then enters it smartly in the gun, pushing it until the cartridge head takes against the extractor.

Q. What precaution should No. 3 take in entering the projectile?

A. He should be very careful not to drive the point of the shell against the edge of the chamber.

Q. In loading, should a jammed cartridge be forced?

A. No; unload at once, and try a new cartridge.

Q. If a second jams, what do you infer?

A. That there is a burr, and it must be filed smooth.

Q. If from any cause the cartridge will not extract, what is done?

A. Catch the head with the extracting-tool, and pull it out; and if this fails, ram it out from the muzzle.

Q. If the nip of the extractor should carry away, what is done?

A. A new extractor is fitted by lowering the breech block clear.

Q. In fitting a new extractor, what should be guarded against?

A. Against inserting the extractor with a cartridge in the chamber, as the nip would then come on the wrong side of the cartridge head.

"POINT!"

Q. What is done at this order?

A. No. 1 steadies the gun with his left arm and shoulder, seizes pistol-grip, finger on trigger, and, with his eyes ranging over the sights, steadies the piece upon the object. No. 2 adjusts sight, and attends trunnion and pivot clamps; at a sliding-pivot mount, adjusts the position of the pivot for train.

"COMMENCE FIRING!"

Q. What are the duties of No. 1 at this order?

A. Rectifies aim, and fires; after reloading, again rectifies aim, and fires; and so on.

Q. What does No. 2 do?

A. Tends sight and clamps, and in quick firing stands by to relieve No. 1.

Q. Who loads after each discharge?

A. No. 3.

Q. What does No. 4 do?

A. Supplies ammunition to No. 3, keeps empty cases clear of gun, and, when ammunition is nearly exhausted, calls out, "Shell," when, with the assistance of No. 3, he provides a fresh supply.

Q. If a cartridge misses fire, what should be done?

A. Withdraw it, examine the mainspring, and try another.

Q. If the miss-fire is repeated, what then?

A. Remove the breech block, feel the firing-pin to see if it is broken, and, if not, change the mainspring before putting the block back.

"CEASE FIRING!"

Q. What is done at this order?

A. No. 1 removes his hand from the pistol-grip, and steadies the gun until the pivot and trunnion clamps are tightened by No. 2.

"UNLOAD!"

Q. What are the duties of the different numbers at the order "Unload"?

A. No. 2 grasps breech-block lever, and draws it back easily; when cartridge has been removed he closes the breech. No. 1 pulls the trigger; then, assisted by No. 2, cleans and oils the mechanism if necessary. No. 3 holds his right hand in the breech-opening, catches the cartridge as it comes out, removes it, and passes it to No. 4, who replaces it in the box, and then closes the box.

Q. What is done at the order "Secure"?

A. The numbers return what they provided, and secure what they cast loose, the gun having first been laid to the securing-position.

Q. What care should be taken with the empty cartridges in returning ammunition?

A. The empty and loaded cartridges are kept separate.

Q. Before stowing the cartridges in the fixed-ammunition room, what should be done?

A. All partially filled boxes should be filled, only one box being left broken.

Gatling gun mounted on board ship, or in a boat. Distribution of the Crew. (3 Men.)

GUN NOS.	TITLES.	REVOLVERS.
1	1st Captain	1
2	2d Captain	1
3	Loader	1

Each member of the gun's crew should be a thoroughly trained rifle shot.

The stations of the crew for mustering when the gun is secured are as follows: For a gun mounted on deck, directly in rear of the gun facing inboard, No. 1 on the right; for guns mounted aloft, on deck, abreast the mast, facing outboard, No. 1 on the right.

CALLS FOR ACTION AND EXERCISE.

Q. What is the signal to clear ship for action?

A. Whistles of the boatswain and his mates, and verbal call. Varies on different ships.

Q. What is the call for quarters for inspection?

A. Ordinary beat of the drum, or boatswain's call.

Q. *What is the signal to leave quarters?*

A. The sounding of the retreat, or boatswain's "pipedown."

Q. *What is the signal for action, or exercise, at general quarters?*

A. The quick beat of the drum.

Q. *When the crew are not at quarters, what is meant by the rapid ringing of the gong?*

A. It denotes emergency, and is the signal for action.

Q. *How are first riflemen called?*

A. Verbally or by the gong.

Q. *How are the second riflemen called?*

A. Verbally, or by the gong while the first riflemen are away.

Q. *How are marine sharpshooters and marines called away?*

A. By verbal order.

Q. *How are first boarders called away?*

A. By the rattle.

Q. *How are the second boarders called away?*

A. By second rattle, the first boarders still away.

Q. *What signal is meant when the ratt gong are sounded together?*

A. "All hands repel boarders."

Q. *Who sounds the gong and rattle?*

A. The gunner's mate.

Q. *When the call for quarters is sounde are the guns manned?*

A. The starboard guns on the spar deck guns on the main deck, starboard guns o deck below, and so on; at sea, the weathe are manned.

Q. *What divisions do not fall in at the*

A. The navigators' and powder divisio

Q. *Where does the navigators' division*

A. In the weather or starboard gangwa cept in spar-deck ships, when it musters port (or lee) gangway.

Q. *Where does the powder division fall*

A. On the berth deck.

Q. *What are the duties of the powder div*

A. It provides the guns with ammu delivering it to the shellmen and powdern the hatches of the decks on which the g mounted.

SUB-CALIBER PRACTICE.

Q. What is meant by sub-caliber apparatus?

A. It is apparatus for reducing the caliber of guns for economic practice.

Q. How is this apparatus fitted in the new B. L. R. guns?

A. A section of a .45-caliber rifle barrel is fitted with three disks, the forward disks just fitting the caliber, and the rear disk being cut with threads that screw in the breech and hold it in position.

Q. How is the firing-apparatus attached?

A. The rear end of the rifle barrel is fitted with threads, and to this the firing-lock is screwed.

Q. Is the firing-lock the same as is used with the gun ordinarily?

A. Yes; the lock is the same, but the firing-pin has a sharper point.

Q. How is the caliber reduced in the rapid-firing and machine guns?

A. The cartridges are made of wood, with brass base and nose cap, and through the center is fitted a section of rifle barrel.

Q. How are these cartridges used?

A. They are loaded with .45-caliber cartridges, and fed to the guns as ordinary cartridges.

Q. What is the advantage of sub-caliber practice?

A. It gives the gun crews practice in aiming.

CARE AND PRESERVATION OF BATTERY.

Q. What is necessary that the guns shall always be in good working order?

A. All the parts must be kept perfectly clean and well oiled.

Q. How often should the breech mechanism be cleaned?

A. If possible, once a day.

Q. Should the breech plug be removed from the tray each time?

A. No; but it must be removed, and the bottom threads cleaned, after every firing.

Q. What parts should be cleaned and oiled once a week?

A. All axles, such as those of trucks; elevating- and training-gear; yoke and pivot bolts; elevating arc bolts, and the inside of the gun.

Q. How often should cap squares be lifted?

A. Once in two weeks.

Q. How are the trunnions, trunnion seats, and other inaccessible parts, cleaned?

A. The gun is raised by hydraulic jack or dismounting-purchase.

Q. How often is this done?

A. Once every month.

Q. Do the piston rods of the recoil cylinders need any attention?

A. Yes; they must be kept free from rust, but no emery cloth or brickdust should be used, except to remove rust unavoidably formed.

Q. What precaution should be taken with the slide face?

A. The carriage should be moved in and out frequently, and the bearing-surface well cleaned and oiled.

Q. What is good cleaning material?

A. Oil and soft rags.

Q. Should water ever be used in cleaning a gun?

A. Yes; after every firing the gun should be carefully washed out with fresh water, using the bristle bore and chamber sponge.

Q. What is necessary after washing the gun with water?

A. Dry it thoroughly with sheepskin sponges, and then see it well oiled.

Q. What portion of the interior requires special attention?

A. The band slope and origin of rifling.

Q. What should be done every fair day?

A. The tompions should be taken out, and the gun allowed to air.

Q. What care should be exercised with the gas check?

A. It should be protected from the weather and everything which can bruise it; the disks should be kept clean and well oiled, and the pad coated habitually with tallow.

Q. What must be done with it after battery practice?

A. The mushroom and check should be removed, well cleaned, and oiled.

Q. Is it ever necessary to refill the recoil cylinders?

A. Yes; they should be emptied, cleaned, and refilled at least once every quarter.

Q. Why is this necessary?

A. Because the liquid — one part water, four parts glycerine — becomes muddy, and deposits a pasty sediment.

Q. After the liquid is taken out, what is done with it?

A. It is strained, fresh liquid added, and the cylinder refilled.

Q. What precautions should be taken before every firing?

A. The cylinders should be examined, and, if necessary, refilled, and the stuffing-boxes properly set up.

Q. Should the gun not return to the battery after firing, what is inferred?

A. That there is too much liquid in the cylinders, that the sliding-surface is scored, or that the stuffing-box is set up too tight.

Q. How can rust in the interior of the gun be removed?

A. Wash the gun thoroughly with a strong solution of potash, allowing an hour or more to dry; then give it a coat of oil.

Q. What is the best oil for lubricating the gun?

A. Sperm oil.

SECONDARY BATTERY.

Q. What care should be taken of the rapid-fire and machine guns?

A. They should be kept clean, free from r and undefaced.

Q. What precautions should be observed their preservation?

A. First: Brickdust or gritty substa must never be used on any part of the g

Second: The parts of the mechanism sh never be scraped with knives or roughene any way.

Third: All parts of the gun must be lightly oiled as a protection against rust.

Q. What should always be done after fir

A. The gun should be cleaned thoroughly

Q. How is this done?

A. The mechanism is dismounted, and barrels and mechanism washed thoroughly warm fresh-water soapsuds.

Q. After washing, what is done?

A. All parts are dried (a short time b allowed to air and dry off moisture), oiled w the mechanism is then mounted.

Q. What should be done once every week?

A. The gun should be inspected, mechar tried, the old oil wiped off, and the gun oiled.

Q. What care should be taken of the small arms of the ship?

A. They should be overhauled, cleaned, and well oiled frequently.

BRONZING STEEL GUNS.

Q. How are steel guns bronzed?

A. Take: —

2 oz. spirits of wine,
2 oz. tincture of steel,
½ oz. muriate of mercury,
¼ oz. sulphate of copper,
1 pint of hot water.

Pound up the two solids in a mortar, and place them with the other chemicals in a bottle. Add the hot water, and seal the bottle.

The preparation should be mixed twenty-four hours before use, and kept well shaken while in use.

The surface to be bronzed must be cleaned thoroughly, and cleared of oil or grease by potash, and washed down with hot water.

Three coats of the bronzing mixture should be put on with a small sponge.

Three hours afterward pour boiling fresh water over the surface, and when dry rub on

boiled linseed oil. After this, polish with crude petroleum (two-thirds) and boiled linseed oil (one-third).

Great care should be taken in cleaning the gun thoroughly before applying the mixture, otherwise it will be spotted.

Q. Why are guns bronzed?

A. To preserve the exterior.

NOTE. — The following receipt for bronzing iron or steel guns was tried on an 8-inch B. L. R. of the *Boston*, producing a beautiful looking piece, easily kept in order and at slight expense: —

Cleanse the parts to be bronzed with potash to remove all grease, and wash off with fresh water. When dry, apply the following solution:

One-half an ounce of sweet spirits of niter.
One-half an ounce of powder of blue vitriol.
One-half a pint of fresh water.
Mix until dissolved.

Rub the mixture well over all parts to be bronzed; let it remain about twelve hours, and, if necessary, touch up bare spots. When completely bronzed, wash off with fresh water.

When the gun is dry, apply the following mixture until a good coat is produced, rubbing each coat in well with the bare hand:

One-half a pint of linseed oil.
One ounce of powdered resin.
One ounce of beeswax, cut small.

Boil together until dissolved, then strain; rub in dry from two to three coats.

When the gun has obtained a good coat, rub up with *clean rags* and a little mineral sperm oil, to polish.

CHAPTER XI.

TORPEDOES.

Q. Into what two general classes are torpedoes divided?

A. Fixed and movable.

Q. What are fixed torpedoes usually called?

A. Submarine mines.

Q. For what are they used?

A. For the defense of harbors and channels.

Q. How are they placed?

A. In shallow water they are laid upon the bottom; in deeper water they are anchored in such a position that the torpedo floats just below the surface.

Q. How are they exploded?

A. Usually by electricity, the current being completed through a fuse either by the contact of the hostile vessel with a circuit closer float-

ing above the torpedo, or by a circuit closer operated on shore. Sometimes they are exploded by mechanical devices actuated by the concussion of the ship on striking.

Q. What is a drifting torpedo?

A. One that floats with the tide or current, the explosion depending upon some mechanical means placed within the torpedo or near it.

Q. What two kinds of movable torpedoes are in use for offensive warfare?

A. Dirigible and automobile.

Q. What are the general methods of control of dirigible torpedoes?

A. They include those operated (*1*) on the end of a spar or boom projecting from the vessel or boat; (*2*) those towed from a vessel under way; or (*3*) those projected towards the enemy, and then remaining under the control of an operator at the point of departure.

Q. Which of these are used on board ships?

A. The (*1*) and (*2*).

Q. What are some of the types of the (*3*) *class?*

A. Lay, Lay-Haight, Patrick, Sims-Edison, and Brennan.

Q. How are these torpedoes controlled?

A. The operator maintains connection with the torpedo by wires; and, usually by an electric current, the course of the torpedo may be changed, the machinery stopped, backed, and the charge fired at will. The propelling-power is electricity, compressed air, or carbonic acid gas. The torpedo is directed by a float and two disks above it, which are kept in line.

Q. What is an automobile torpedo?

A. One which, after being projected towards an enemy, acts automatically, and continues its course.

Q. How is this done?

A. It contains its own motive power and directing-mechanism, which is set in motion just before or at the moment of being launched.

Q. When are these torpedoes used?

A. They are used for coast defense in narrow channels from shore stations, but more generally for attack by torpedo boats, and from ships themselves.

Q. What two types of automobile torpedoes are used in the navy?

A. The Howell and Whitehead.

THE HOWELL TORPEDO.

Q. What is the general shape, and dimensions, of the Howell torpedo?

A. The general shape is that of a head being ogival, the main body cy and the after body a spindle. The di of the normal torpedo are as follows:-

Diameter	14.2
Extreme length	11.1¾
Launching weight	518
Weight of explosive carried . .	99.4
Speed for 400 yards	25
Effective range	750

Q. How is the torpedo launched?

A. From a launching-tube mounted the ship or torpedo boat, with center pivot where lateral train is possible.

Q. What is the launching-apparatus

A. It consists of a bronze tube 11 f and bored to take the larger diamete torpedo easily, and closed at its rear an air-tight door hinged laterally. Un (or on the side), and secured to the m are two smaller brass tubes, connected by a cross pipe near the forward en right tube, called the firing-tube, has *to its rear* end a breech piece, char

carry an ordinary metallic cartridge case, and closed with a simple breech block, with either percussion or electric firing-mechanism. The left tube, called the compression tube, connects with an elbow to the main tube in rear of the torpedo. The charge of powder being ignited, the powder pressure, together with the air pressure created in the firing-tube, and transmitted through the compression tube onto the tail of the torpedo, is sufficient to eject it from the tube.

Q. What charge of powder is used; and what is the velocity of launching?

A. Five or six ounces of black cubical powder give an initial velocity of 35 knots an hour; such that, if launched from a height of 5 feet, it will take the water 30 feet from the ship.

Q. What furnishes the motive power of the torpedo after it takes the water?

A. The energy stored in a heavy steel fly wheel, which is spun up preliminary to discharge to about 10,000 revolutions per minute.

Q. What is the weight of the fly wheel?

A. 131 pounds.

Q. How is the speed of revolution given the fly wheel?

A. By a steam-turbine motor bolted to tube and having a clutch, moving throug hole in the tube, and readily engaging or di gaging a corresponding clutch in the torped the end of the axle of the fly wheel.

Q. How is the initial direction of the tor maintained?

A. By the high speed of revolution of heavy fly wheel, which having its action l zontal in the sectional plane of the torp gives great gyroscopic stiffness, such that torpedo being projected in any direction te to maintain its horizontal direction with g persistence.

Q. What is the path of the torpedo after l ing the tube?

A. At a determined depth below the sur of the water, and in the straight line of charge, subject to the action of currents.

Q. How is the depth of immersion fixed maintained?

A. By a hydrostatic piston which regul the depth as desired, and a pendulum wl modifies the angle of ascent and descent. piston is set for a water pressure of the requ depth, and is connected with the tiller o *horizontally* placed rudder, which for the

sired pressure is exactly horizontal. Any movement of the torpedo from this depth moves the piston, actuates the rudder, and brings it back.

Q. How is the pendulum arranged, and what is its action?

A. It is fitted with a heavy bob, and swings in the fore and aft line of the torpedo from a knife edge in the top. By the swing of the pendulum, when the torpedo is ascending or diving, and by the motion of the piston when above or below the set depth, the horizontal rudder is actuated and the horizontal position of the torpedo maintained.

Q. How is the movement of the piston or pendulum transmitted to the rudder?

A. By the reciprocal movement of two impulse racks, driven by gearings from worms on the shafts. When the piston or pendulum moves from its normal position, it tips an angle guide to one side or the other. The tiller rods end in two small pivoted arms called pallets; and one end of these rests against springs attached to the ends of the angle guide, the movement of which throws the free end of the arm engaging the teeth of the moving rack. The impulsive movement thus given is transmitted through the

tiller rods to the rudder. When in the normal position again, the arms of tiller rod are disengaged from the rack, and motion ceases.

Q. How is the horizontal position of the torpedo quickly gained when first launched?

A. By a mechanism which locks the pendulum for a second or two (when the torpedo is launched). The pendulum is locked either forward or aft, thus giving either up or down rudder. This depends upon the height of the tube above water. The pendulum is then released automatically.

Q. What is the vertical rudder used for?

A. To bring the torpedo back to its initial course when deflected by a sudden temporary extraneous force.

Q. How does it act?

A. Any force tending to change the course of the torpedo causes it to roll; this rolling, by means of a transverse pendulum and suitable mechanical devices, moves the rudder to one side or the other, and brings the torpedo back to its initial course.

Q. How is the torpedo driven?

A. By two screw propellers, placed side by side, and geared to the hub of the fly wheel by miter wheels in the ratio of five to four.

Q. How is the speed of the torpedo regulated during the run of the torpedo?

A. It is maintained constant by an automatic pitch mechanism which constantly increases the pitch of the blades of the propellers as the speed of the fly wheel is decreased.

Q. What is the head of the torpedo?

A. It is the front compartment, made of sheet brass, and strongly braced. It is almost completely filled with wet gun cotton, a small water-tight section being reserved to contain the dry gun-cotton primer and detonator. To the front of the head is secured the nose carrying the firing-mechanism.

Q. What is the firing-mechanism?

A. It consists of a stout steel firing-pin traveling in guides in the nose-piece casting, and held forward by a soft lead shearing-pin against the tension of a strong spiral spring. Its outer end is fitted with a four-bladed propeller, which, by the movement of the torpedo, travels on a thread to the ends of the pin, where it brings up against a nut; and in this position, by the blow of impact, the shearing-pin is sheared, the firing-pin flies to the rear due to the blow aided by the action of the spring, striking and exploding the fulminate *of mercury* detonator, and igniting the charge.

Q. What are some of the qualities of the Howell torpedo?

A. It has great directive force, preserving the original course of discharge, and if temporarily deflected, quickly regaining it. It can be forced to maintain a certain determined depth below the surface, and if it fails to explode on contact, or misses the target, is rendered inoperative.

Q. How is the torpedo loaded, and fired from the launching-tube?

A. To load the torpedo into the tube, it is simply necessary to push it in until a guide stud on its side surface brings up against a stop projecting into the tube from the side, and held in place by a spiral spring. The door is then closed and fastened, the clutches on the rotating-motor and torpedo axle shaft being fair for engaging. The powder charge is now placed in the firing-chamber, the clutches engaged, and the throttle valve of motor opened, and the fly wheel rotated to the desired number of revolutions. *To fire,* a lever is pushed forward which shuts off steam from the motor, withdraws the motor clutch, withdraws the stop pin, and then fires the charge.

Q. What are some of the precautions taken to prevent premature fire?

A. The entire firing-mechanism is removable, and only placed in the nose of torpedo just before loading, being fitted with a bayonet joint or slotted screw. The detonator is also stored separately, and inserted just before the firing-mechanism. The hammer of breech block cannot be cocked until the motor and axles are clutched ready for spinning; and the charge cannot be ignited until the stop pin has cleared the guide stud, and the torpedo is clear for leaving the tube.

THE WHITEHEAD TORPEDO.

Q. What are the shape and dimensions of the Whitehead torpedo? [1]

A. It is cigar shaped, with a bluff head; is from 14 to 18 inches in diameter, and from 11 to 16 feet in length; weight, 836 pounds; charge of explosive, 120 to 220 pounds of wet gun cotton; its speed is about 30 knots per hour, and effective range 400 to 800 yards.

Q. How is the torpedo discharged?

A. From a launching-tube mounted on a carriage in the bow or stern of the vessel, or in broadside, either above, below, or on the surface of the water.

[1] *The 18-inch torpedo* is the size used in the U. S. Service.

Q. What gives the initial impetus of discharge?

A. A charge of 4 oz. of gunpowder, or a piston worked by compressed air.

Q. What is the motive power of the torpedo?

A. Air compressed to 1350 lbs. in a reservoir, the middle body of the torpedo, working a Whitehead single-acting engine with three cylinders 120° apart, the main crank receiving an impulse from the piston of each cylinder in succession, and driving the propeller shaft.

Q. How is it driven?

A. By twin two-bladed screws in tandem, and revolving in opposite directions; one on the main shaft, the other on a sleeve around the main shaft, and driven by bevel gear on the main shaft and on the sleeve.

Q. How is the course of the torpedo directed when the torpedo has left the tube?

A. It starts in the direction of discharge, and is made to maintain that direction, subject to the effect of currents, by vertical vanes set at an angle previously determined by experiment.

Q. How is the required depth of immersion reached and maintained?

A. In the same general way as in the Howell torpedo; by a hydrostatic piston and balance, an index actuating horizontal rudders. By a dial on the exterior surface of the torpedo, the desired depth may be regulated before firing.

Q. What is the buoyancy chamber?

A. An air-tight chamber in the after body of the torpedo, to give it a certain preponderance of buoyancy, to insure the rising of the torpedo if desired, or by flooding the chamber to sink if it misses the target or fails to explode.[1]

Q. Where is the magazine?

A. In the forward compartment of the torpedo, and contains 120 pounds of wet gun cotton — in the short torpedo (Mark I. and II.), and 220 in the 5 meter torpedo — the dry gun-cotton primers, fulminate of mercury detonator, and firing-mechanism.

Q. Of what does the firing-mechanism consist?

A. Of a detachable stock screwing into the magazine envelope and primer case, and carrying a firing-pin, which is held away from the detonator by a tin shearing-pin. Through the

1 A spring around steering-rod, after air has been shut off steering-engine, gives the torpedo up rudder, and brings it to the surface.

stock passes a shaft, fitted at its outer end with a four-bladed propeller, which is rotated by the passage of the torpedo through the water, and screwing backward an inner sleeve, until the sleeve is brought up against the head of the firing-pin. Impact with the target drives the shaft against the stock, and through the medium of the inner sleeve shears the safety pin, and drives the firing-pin against the detonator, exploding it, and igniting the charge.

Q. What are some of the qualities of the Whitehead torpedo?

A. If fired in still water, it will maintain the initial direction of discharge, provided an allowance is made for action of currents. If adjusted to a certain depth, and projected above water, on the surface, or beneath, it will attain that depth, and maintain it during the run. It can be adjusted to stop after running any distance up to extreme range, and after stopping, to float or sink.

CHAPTER XII.

ARMOR AND OTHER PROTECTION.

Protection, more or less efficient and extensive, according to each special case, is now sought to be given to all ships, guns, machinery, and personnel, by the use of *armor plates, belts of water-excluding material, armored decks, gun shields, armored conning-towers, coal protection.*

Nickel Steel Armor. — The competitive tests held at Annapolis in September, 1890, of compound armor, steel armor, and nickel steel armor, or an alloy of steel with about 5 per cent of nickel, demonstrated practically without a doubt the superiority of the nickel steel plate over the others, and led to the adoption of nickel steel as the metal to be used in future manufacture. Subsequent tests, both in Europe and the United States, have confirmed the first result.

Advantages. — The alloy of nickel with steel produces a metal of great ductility and tough-

ness, with extraordinary resistance to cracking, under the powerful blows delivered by projectiles of high energy. The resistance to penetration simply is perhaps not greater than that of simple steel of good quality; but the ability to stand the shock of penetration, up to the full power of the plate without cracking, is a quality of the highest order, hitherto not possessed by any other armor.

Systems of Applying Armor. — Armor protection is now divided into three systems; namely, — *the belt system, the central citadel* or *barbette system,* and *the deflective system.*

The Belt System. — This consists in protecting the whole water line by an armored belt, the armor being thickest abreast the engines and boilers, and the armor tapers in thickness from a short distance below the water line down. The guns are protected either by breastworks, turrets, or armored barbettes, the other parts of the ship being left unarmored. The French use this system to the exclusion of all others. The monitors may be classed under this system.

The Central Citadel System. — With this *system,* only that part of the water line abreast *the engines* and boilers, or in the wake of am-

munition hoists, is armored. The forward and after parts of the hull are left unprotected at the water line and above; but a deflective steel deck extends from the citadel forward and aft, and is so placed and shaped as to prevent projectiles from penetrating to the compartments below. The parts of the hull are subdivided into numerous compartments; and it is claimed that even if those portions above the deflective deck be destroyed or filled with water, that having a reserve of flotation, the ship's stability will not be endangered. The guns are protected by turrets or barbettes as the case may be.

The Deflective System or Inclined Armor. — This system has been adopted as the water-line defense of cruisers, for gun shields, for shields of turrets, and is used, in combination with vertical armor, for portions of the water-line defense of armored ships. It consists in placing the armor plate at an angle to the line of fire of projectiles, so that the latter may be deflected on impact. To attempt to protect a ship by what is known as "steep inclination," or when the angle of inclination of the plate with the horizontal is 45° and upward, there is nothing gained over the vertical plate if flat-headed projectiles, or those having a head of such a shape

that the projectile will bite the plate at 45° or greater angles of inclination from the horizontal, are used. The same length and height must be covered, and the same weight of armor used, while no greater protection to penetration is afforded, because the armor for the same weight is thinner in proportion to the sine of the angle of inclination, while the energy for penetration decreases in exactly the same proportion. But when the angle of inclination is such that the head will not bite the plate, the projectile glances off, unless the normal component of the energy is enough to smash a hole through the plate, in which case the damage will be caused by flying splinters, the projectile itself being carried off.

Armor Fastenings. — Armor plates are now fastened to the hulls and backing by heavy bolts, varying in size according to the weight of plate. Those for the armored 6,000-ton ships are from $2\frac{3}{4}$ to 3.1 inches in diameter, and from 18.45 inches to 23 inches in length. They are screwed into the armor at the back, and do not go through the plate. They pass through wrought-iron tubes in the backing, and set up against the inner skin with steel cups, nuts, and washers.

Armor Shelf. — The weight of the side armor *is supported* by the armor shelf.

Gun Shields. — Gun-shield tops are, as a rule, inclined at an angle of about 20° with the horizontal; and as the plates are of high quality, the normal energy of 6-pounder and 3-pounder R. F. G. projectiles is not enough to penetrate them. Some gun shields for heavy guns are, however, sections of cylinders, about seven feet high and two inches thick. Later types consist of a cylindrical vertical shield with an inclined shield top, the vertical armor being at least two inches thick, and the shield top one inch thick.

Armored conning-towers are generally of circular or oval shape, with a top, placed, as a rule, forward and high enough to command a nearly all-around view. The post of the captain during battle is within the conning-tower, where are placed the battle steering-wheel, electric apparatus for the concentrated firing of the battery, voice tubes, indicators, etc.

Water-Excluding Belts. — Cellulose and woodite have been used for water-excluding belts near the water line; and while opinions differ as to the efficacy of such protection, it will doubtless be used to some extent. The action of water on cellulose or woodite causes it to swell and fill up the shot hole. The material is stowed compactly, but in bulk, in the compartments provided; and its action is best when thus used.

It does not burn readily; but when attacked by melinite shells it has been known to burn quickly, and its value to stop the large hole made by a high explosive shell is very limited.

Coal Protection. — Good protection against the fire of medium guns and the lighter calibers of armor-piercing guns has been obtained for the engines and boilers, etc., of unarmored cruisers, by placing loose coal in bunkers, subdivided by bulkheads, outboard, outside and above the protective deck; and from experiments made in England, it may be said that for protective purposes *two feet thickness of coal is equivalent to one inch of iron,* roughly speaking.

When filled shell are used, the effect is less than when blind shell or shot are used. The shells bursting in the coal have no incendiary effect, and but little disruptive effect. It should be remembered, however, that cruisers depending upon coal protection are more vulnerable as their time at sea increases and their supply of coal runs out.

Steel splinter bulkheads are sometimes fitted between the guns of a ship's battery to protect the gun's crews from flying fragments of shell, or from pieces torn off the sides of the ship. A *mantlet* made of pieces of rope hawsers is

the form of a heavy mat will sometimes serve the same purpose, except for the large pieces of shell, and may be placed when the ship is cleared for action.

RULES FOR THE ATTACK OF ARMORED SHIPS.

1. *Against Iron Armor.* — The projectile must have at least 1,000 feet striking-velocity for each caliber in thickness of armor. Steel-forged armor-piercing shells, unfilled, should be used when perforation[1] is to be attempted, unless the guns are of very high power compared to the armor. Steel-filled shells or drilled-iron filled shells are useless against thick armor.

2. *Against Steel or Compound Armor.* — The chance of penetration by a single blow is small, but continued fire may break up the armor. This armor must be fractured.

3. *Against Wrought-iron Armor.* — This must be penetrated, and is effected by the power of the gun for penetration. In all cases guns incapable of doing the primary work indicated would be used against the tops, exposed guns, and unarmored parts.

[1] *Punching* is the distribution of the blow over a small area. An elongated projectile of high velocity is used to *pierce a hole* through the target. *Racking* is the *distribution of the blow* over a large area.

APPENDIX.

THE NEW NAVY RIFLE.

THE system is the Lee straight pull, with fixed central under-receiver magazine, filled by packets of five cartridges held by a clip or charger. The bolt handle turns permanently down, close to the stock above, the trigger guard, and then projecting, ends in a knob, so placed that it may be grasped by the thumb and first finger, while the second finger is on the trigger. In opening the breech, the first part of the nearward motion of the bolt handle is an oscillatory motion in a vertical fore and aft plane, raising the rear or locking face of the bolt — which is of rectangular cross section — clear of the locking shoulder of the receiver; afterwards the bolt is drawn to the rear by the continued motion of the handle. This gives but one point of support, and some distance in rear of the chamber; but it is of ample area, axially placed, *and on trial* endured nearly 3,000 fires, a large pro-

portion of which developed a pressure of about 60,00(
pounds per square inch.

The extractor, which is likewise the ejector, i secured to the left of the bolt, and has play of abou an inch in a fore and aft direction. When the bol first moves to the rear, the extractor remains fixec but is started sharply after the bolt has moved short distance, giving the shell a blow, which result in remarkably easy and certain extraction. Whe the shell is clear of the chamber and side of the re ceiver, the extractor, pressed against it by a spring throws it out.

Five shots have been fixed in three seconds, begir ning with the piece charged, and ten in thirteen sec onds, beginning with it empty. To avoid danger c opening the chamber before the trigger has bee pulled, which might occur in rapid firing, it is mad impossible to withdraw the bolt before pulling th trigger, without pressing a simple catch to the left c the receiver, which releases the bolt. A safety loc is provided in the shape of a vertically movin thumbpiece on the left of the receiver, which allow the piece to be carried loaded and cocked, but locke against discharge, until the safety lock is pushe down.

The clip system is designed to combine the adva

tages of those now in use, without possessing their disadvantages. It is a mere strip, holding the heads of the five cartridges securely in transportation, and entering with them into the magazine; but the action of charging releases the cartridges from the clip, which drops out below: thus the clip forms no essential part of the magazine. The magazine may be charged with single cartridges, or the piece used as a single loader; but it is intended to be used only as a multiple loader, and is without cut-off.

The barrel is of nickel steel, and 28 inches long. The rifling is of a uniform twist of one turn in about 7.5 inches. The Metford rifling (in which the grooves are arcs of circles), is used. The caliber is 6 mm. (.236 inch).

The standard navy ball cartridge consists of case, primer, bullet, and charge. The case is drawn brass, with connection for contractor rib; the bullet hardened lead, with jacket of cupro-nickeled steel, weight 135 grains; the charge consists of 33.2 grains of Troisdorf smokeless powder; primer similar to .45 caliber. With this ammunition, at 60 feet from muzzle with average chamber-pressure of 46,000 pounds, an average velocity of 2,460 feet per second can be obtained, which gives a penetration of 62 inches of *pine, five* feet from muzzle, and $\frac{7}{16}$ inches of boiler

plate at muzzle, and $\frac{3}{8}$ inches at 100 feet. The ammunition, with clips, weighs about one-half that of the old Springfield .405-grain bullet. The bayonet is the knife pattern, about 8¼ inches in length, and fits underneath the barrel. The piece with bayonet and sling weighs 9 pounds 7 ounces, while the piece alone weighs 8 pounds and 8 ounces.

MANUAL FOR COLT'S DOUBLE-ACTION NAVY REVOLVER.

ORDERS.

CAUTION.	PREPARATION.	EXECUTION.
1.	Pistol.	Draw! 1.
2. *Round.	Single Aim. / Single Snap.	Fire! 2.
*Round.	Double Aim. / Double Snap.	Fire! 2.
3.	Cartridges. / Pack.	Load! 3.
4.	Return.	Pistol! 4.

* Cautionary order "Round," to be given only when all chambers are to be emptied.

1. "Pistol, Draw!" (1 time, 2 motions.) At the order "Pistol," carry the right hand to the holster, loosen the flap catch by an outward and upward pull of the flap, pass the fingers under the grip, and loosen pistol in holster.

"Draw!" Draw the pistol from the holster, and carry it in to the right shoulder, barrel vertical,

hammer at height of shoulder, fingers clear of trigger and in rear of trigger guard.[1]

2. "Single, Aim, Fire! (1 time and 3 motions.) "Single:" full cock, and carry first finger to trigger. "Aim:" extend the right arm straight to the front, elbow very slightly bent, and aim at the object with fore sight filling notch to top of the frame.

"Fire!" Pull trigger, and return to position, "Pistol, Draw."

"Single, Snap, Fire!" As before, except that the object will be pointed at without running the eye over the sights.

"Double, Aim, Fire!" As before, except that the piece will not be brought to full cock.

"Double, Snap, Fire!" As before, except that the sights will not be used.

When cautionary orders, as Round, Two, Three, etc., are given, all chambers will be emptied, or the designated number of shots delivered before coming to the position, "Pistol, Draw."

[1] When the cutlass is worn with the revolver, the holster will be on the right hip, normally just in rear of the hip joint; but it may be moved in front of the hip at order, "Pistols, front," when the occupation of the men is such as to make this last-mentioned position more desirable.

When the cutlass is not worn, the holster will be on the left hip, normally in rear of the hip joint, but it may be moved to the front as before.

3. "Cartridges, Load!" (1 time and 3 motions).

1st motion. Carry the left hand in front of the body, left forearm pointing 45° to the right, and slightly above the horizontal, palm of the hand up. Drop the piece into it, latch up, cylinder in the palm, barrel between thumb and first finger, muzzle 45° to the left and 45° *below* the horizontal. With thumb of right hand unlatch cylinder, and with second and third fingers of left hand turn out cylinder, pressing crane firmly back, first finger resting on barrel at joint of frame, and fourth finger on hammer. With thumb of left hand applied to ejector-rod head, press rod home slowly, and hold it in that position while any fired cartridge cases that have not fallen off are brushed aside by first finger of right hand. Allow thumb of left hand to slip from rod head, and rest on the cylinder. Carry right hand to cartridge box and loosen catch.

2d motion. With the thumb and first finger of the right hand take a cartridge from the box, and place it in an empty chamber. Continue this till all chambers are loaded. With right hand fasten cartridge-box flap and grasp grip of pistol, finger clear of trigger. With thumb of left hand press cylinder home. Elevate muzzle 45° above the horizontal. *Release thumb* pressure, and with second and third

fingers press back and upward on cylinder, thus rotating it, and testing security of latching and freedom of rotation.

3d motion. Resume position, "Pistol, Draw."

"Pack, Load!"

Same, except: —

1st motion. Drop piece into left hand with the muzzle 45° *above* horizontal, and in ejecting press rod head home smartly; then drop muzzle to loading position in "Cartridgés, Load."

2d motion. With thumb and second finger of right hand take a pack from the box, first finger on plug head. Place plug point in latch seat in ejector, lift first finger from plug head, and press on pack ring with thumb and second finger; then proceed as in "Cartridges, Load."

4. "Left arm rest, Single, Aim, Fire!" At the order, "Left arm rest," grasp the right forearm near the elbow with the left hand, and make a half face to the right.

"Single!" Full cock the piece.

"Aim!" Drop the right hand into hollow of left arm, with joint between cylinder and barrel outside of elbow, raise the left arm, and aim with full sights.

"Fire!" Pull the trigger, steadying the piece with grasp of left hand on right forearm.

5. Return Pistol. (1 time and 2 motions.) "Return!" Drop the muzzle, and enter it in the holster.

"Pistol!" Thrust it home, and fasten flap.

The revolver is sighted, full, for 20 yards, but the "flip" counterbalances the curve of trajectory up to 120 yards. Inside of 25 yards the shooting will be slightly high.

The double pull, being heavy and "creepy," is not well adapted to aimed fire.

The single pull of from 6 to 8 pounds may be lightened by slacking the strain screw when nice target work is wanted. With the strain screw slackened off, the mainspring will still have sufficient resilience for firing on the single, but it will not be sure on the double pull.

DISMOUNTING AND ASSEMBLING COLT'S DOUBLE-ACTION NAVY REVOLVER.

Turn stock screw partly out, and press on screw to loosen half stocks, and remove these last.

Turn out tap screws, tap guard, and frame with screwdriver handle to loosen cap, and remove cap.

Slip out hand and spring.

Pass wrench handle between frame and mainspring, with neck of handle at curve of frame under

swell, width of handle forward of curve, and by twisting wrench cam spring down till stirrup can be throw off. Slip mainspring out.

Draw hammer off pin.

With widest part of wrench handle applied at curve of frame under swell, cam down rebound-spring, and slip rebound lever off pin. Draw trigger off pin. With large drift drive out rebound-spring pin, and remove spring.

Turn out crane-lock screw, and remove lock.

Grasp crane at flat, and draw it forward, thus compressing ejector spring. Turn cylinder till any flute indexes with crane joint on frame, and remove cylinder and crane.

Press latch fully back, and with small drift applied through hole in latch, push out latch-spring pin. Remove latch and spring.

With large drift drive out strut pin, and remove strut and spring from hammer. With small drift push out stirrup pin.

With large drift turn off ejector-rod head, and with ejector wrench turn off ejector — *left-hand thread* — and remove cylinder.

With crane-nut wrench turn out crane nut — *left-hand thread* — and remove ejector rod and spring.

The barrel will not be unscrewed from the frame, nor any pins driven out, other than those before mentioned, except to replace broken hammer pin.

To Assemble. — Proceed in the reverse order, except: —

I. After screwing on the ejector until the guide pin indexes with its hole, set out the end of the rod lightly with the set.

When replacing a broken ejector rod, screw the ejector down to the shoulder, then back off till the guide pin indexes properly, and use the set, as before.

II. *To Assemble the Latch in the Frame.* — Seat the latch with its spring in place. Then with the large end of the large drift compress the spring, pushing on the small end with the thumb of the left hand, and holding the latch in place with the forefinger of the same hand applied to the cylindrical part.

With the right hand enter the latch-spring pin in the hole from the cap side of the frame, and push it home, working it over the last coil of the spring, and at the same time releasing gradually the pressure on the drift.

III. See that the guide pin in cap is to rear of handspring before pushing cap forward to place.

IV. In assembling, place crane-lock screwhead in

slot in lock, and enter both together; then turn screw home. In this way the grasp of the lock on crane is insured. Be sure the crane lock enters its slot, which will be known by heads of lock and screw coming nearly flush with frame when set up.

Ejector rod is of best Stubbs steel, untempered. It will spring slightly, and may be set by abuse. In case rod is bent, place pistol on bench, right side down, and with cylinder turned out. Hold crane back with left hand, and revolve cylinder with right, noting the throwout of rod head. Turn rod head till the throw is up, and tap it with screwdriver handle. Revolve again to test alignment. Proceed in this way till rod is straightened.

The screwdriver handle has been designed for use as a mallet in all work about the revolver. Hold it by the neck, and deliver blow with butt end. Never hold by the blade and drive with side of handle.[1]

[1] A new Colt's revolver is now being issued, which is an improvement over the old, insomuch as the cylinder can only be revolved by cocking the piece, and the pistol cannot be fired until the cylinder is in place.

RANGE-FINDING AT SEA.

In finding the range at sea, whether in actual engagement or at target practice, the following methods may be resorted to: —

ANGLING ON SOME KNOWN LENGTH OF THE TARGET.

Knowing any dimension of an enemy's ship, such as the height of the mast or smokestack, distance between its masts or its length (when the ship is broadside on), by angling with the sextant, the distance may be found within a few yards.

THE TRAVEL OF SOUND.

Remembering that the travel of sound in air is about 1,100 feet per second, and that the travel of sight is inappreciable, by noting the number of seconds that elapse between the flash and the report of a gun, the distance may be approximately obtained. For this method the Boulengé telemeter has been devised. It consists of a glass tube about six inches

long and half an inch in diameter, in which a piston falls by its own weight when the cylinder is vertical. The instrument is turned into the vertical position when the flash of a gun is seen, and horizontal when the report reaches the observer. The distance the piston has fallen, shown on the scale, gives the distance of the gun.

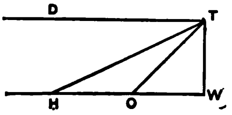
FISKE RANGE FINDER.[1]

The principle of the Fiske Range Finder depends upon the electrical resistance of a conducting body, the length, and therefore the resistance, of which is made to depend upon the angle included between two lines of sight directed upon the target. The instrument consists of a pair of electrically connected plane tables, one at each end of a base line (some measured length on the vessel), and upon each of which is a telescope. These telescopes are directed upon the target, the distance of which determines the angle between their axes, thereby varying the resistances of the two conducting bodies, and causing a deflection of a galvanometer, which is graduated in yards, so that the distance may be read off directly. To facilitate communication between the observers, the plane tables are connected by telephone.

[1] By Lieutenant B. A. Fiske, U. S. Navy.

BUCKNER'S METHOD.[1]

In the figure, T represents the position of the observer somewhere aloft; TW, height above the water line; HW, the sea level; O, the object whose distance is required; and H, a point in the horizon. The observer from the top or cross trees measures with a



sextant the angle HTO; and as DTH represents the dip, we have $OTW = 90 - (HTO + DTH)$, from which OW can be found. To use the table, look in the column corresponding to the distance of the eye above the level of the sea, with the observed angle, and opposite to it, in the column marked Distances, will be found the distance of the object in yards.

[1] By Lieutenant W. P. Buckner, U. S. Navy.

Table for Buckner's Method.

YARDS.	HEIGHT OF THE EYE ABOVE THE LEVEL OF THE SEA, IN FEET.								
DISTANCE.	20	30	40	50	60	70	80	90	100
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
500	.41	1.03	1.25	1.48	2.10	2.32	2.54	3.17	3.39
600	.34	.52	1.10	1.29	1.47	2.05	2.24	2.42	3.01
700	.28	.44	1.01	1.15	1.31	1.46	2.01	2.18	2.34
800	.24	.38	.51	1.05	1.18	1.32	1.46	2.00	2.13
900	.21	.33	.45	.57	1.09	1.22	1.33	1.45	1.57
1000	.18	.29	.40	.50	1.01	1.12	1.23	1.34	1.45
1100	.16	.26	.35	.45	.55	1.05	1.15	1.24	1.34
1200	.15	.23	.32	.41	.50	.59	1.08	1.17	1.26
1300	.13	.21	.29	.37	.45	.53	1.02	1.10	1.18
1400	.12	.19	.27	.34	.41	.49	.57	1.04	1.12
1500	.11	.18	.24	.31	.38	.45	.52	.59	1.07
1600	.10	.16	.22	.29	.35	.42	.48	.55	1.02
1700	.09	.15	.21	.27	.33	.39	.45	.51	.58
1800	.08	.14	.19	.25	.31	.36	.42	.48	.54
1900	.08	.13	.18	.23	.29	.34	.39	.45	.50
2000	.07	.12	.17	.22	.27	.32	.37	.42	.47
2100	.06	.11	.16	.20	.25	.30	.35	.40	.45
2200	.06	.10	.15	.19	.24	.28	.33	.38	.42
2300	.05	.10	.14	.18	.22	.27	.31	.36	.40
2400	.05	.09	.13	.17	.21	.25	.29	.34	.38
2500	.05	.08	.12	.16	.20	.24	.28	.32	.36

No correct use of this table can be made when the proximity of land interferes with the distance of the horizon.

PLOTTING TARGET PRACTICE.

To determine the scores in target practice, the shots are plotted upon an imaginary vertical target, placed perpendicular to the line of sights, its center being at the real target.

Two observers, each in a boat anchored at 500 yards or more from the target, record the splash of the shot, in degrees, to right or left of the target. These angles are measured by means of T's, instruments resembling a rake. When a gun flash is seen, the time is noted; the observer at once holds the long handle sighted on the target, and reads upon which division (or tooth of the rake) the splash of the shot falls. The T's are graduated up to 20°, and may be read to a quarter degree.

The boats are placed [1] by each steering a fixed

[1] In laying out boats, the observer should, before leaving the ship, see that the anchor, buoys, compass, sextant, and T's are in the boat; get the approximate course to be steered; compare his watch with the chronometer; see that his record book contains a table of masthead angles; and acquaint himself with the steering *signals*, usually a flag at the masthead: at masthead, *Steady; above* lower yard, Right; below lower yard, Left.

course from the ship, till the mainmast of the sl subtends the angle (observed from the boat with t sextant) corresponding to the distance requir When the boats are in position, as shown by sig (usually shipping the colors), the ship drops the t get and steams to her position (in a line between t boats) for firing. The boats form with the target isosceles right triangle, the right angle being at target.

After practice, the observers will have records the following form:—

LEFT BOAT.				RIGHT BOAT.			
No.	Time.	Degrees Left.	Degrees Right.	No.	Time.	Degrees Left.	Degr Rig
1	10.02.15	. . .	. . .	1	10.02.17	. . .	:
2	.03.07	. . .	. . .	2	.03.10	1	. .
3	.04.30	. . .	. . .	3	.04.30	. . .	1(

After comparison of watches, times, and number shots, the points of fall of the shots are plotted u prepared blanks from the records. The blanks rep sent, in reduced size, the place of practice, show the positions of the boats and target; as aids in pl ting, lines are drawn one degree apart, radiating fr each boat, extending 20° to the right and left of t *target.*

Knowing the position of the ship at the instant of firing, the distance to the right or left at which the shot passed the target, and with this the distance beyond or short of the target at which the shot struck, may be taken off the plan with dividers. Knowing the range of the shot (from records of other observers on the ship), and its error, short or over, the distance above or below the center of the target may be found from computed tables; the position of the shot on the imaginary vertical target will then be determined.

U. S. Naval Code of Signals.

	1	2	3	4	5	6	7
CHARACTER.	WIG-WAG. — FLAG, TORCH, OR FLASH LANTERN.	ELECTRIC NIGHT SIGNALS.	SPECIAL SIGNIFICATION.	FOG WHISTLE, FOG HORN, BUGLE.	GUN FIRE, BELL, OR GONG.	VERY'S CODE.	SHAPES.
A	2 2	W W	*C. A. U.	Same as columns 1 and 3. — The 1 of the Wig-wag is one toot. — The 2 is two toots. — The interval is one blast.	2 2		To be prescribed.
B	2 1 1 2	W R R W	0		2 1 1 2	G R R G	
C	1 2 1	R W R	Repeat.		1 2 1		
D	2 2 2	W W W	*T. D. U.			{R G}	
E	1 2	R W	Error.		1 2		
F	2 2 2 1	W W W R	4		2 2 2 1	G G G R	
G	2 2 1 1	W W R R	6		2 2 1 1	G G R R	
H	1 2 2	R W W	*A. S. U.				
I	1	R					
J	1 1 2 2	R R W W	5		1 1 2 2	R R G G	
K	2 1 2 1	W R W R	Negative.		2 1 2 1	G R G R	
L	2 2 1	W W R	*G. L. U.			R G } + rocket.	
M	1 2 2 1	R W W R	9		1 2 2 1	R G G R	

N	11	R R	*C. B. U.			
O	21	W R	*C. C. U.			
P	1212	R W R W	Affirmative.		1212	R G R G
Q	1211	R W R R	Interrog.		1211	R G R R
R	211	W R R	*I. C. U.			
S	212	W R W	*G. S. U.			
T	2	W				
U	112	R R W	*N. L. U.			{R/G} {R/G}
V	1222	R W W W	7		1222	R G G G
W	1121	R R W R	Annul.		1121	R R G R
X	2122	W R W W	Numerals.		2122	G R G G
Y	111	R R R	*V. N. U.			
Z	2222	W W W W	2		2222	G G G G
Cornet.	1111	R R R R	1		1111	R R R R
Letters.	1112	R R R W	3		1112	R R R G
Code Call.	2111	W R R R	8		2111	G R R R
Interval.	2212	W W R W	Interval.	Blast.	3	G G R G

* The initials C. A. U., T. D. U., etc., are Code Calls, and stand for "Cipher 'A' Use," "Telegraphic Dictionary Use," etc. (see Code Calls). In the Electric System the upper light of W W, W W W, R W W, etc., is pulsated. Columns 2 and 3 correspond to the markings of the new key-boards of the electric apparatus to be furnished vessels of the Navy, and *are not intended to be memorized.*

AIDS TO MEMORY.

THERE are only 30 characters in the Code. All have two meanings excepting the "Interval," which is neither a letter nor a numeral. The numerals duplicate seven letters of the alphabet, *b*, *f*, *g*, *j*, *m*, *v* and *z*.

THE NUMERALS ARE:

1	1111	(Cornet.)	2	2222	(Z.)
3	1112	(Letters.)	4	2221	(F.)
5	1122	(J.)	6	2211	(G.)
7	1222	(V.)	8	2111	(Code Call.)
9	1221	(M.)	0	2112	(B.)

The word "TADZ" is **2-22-222-2222.**
The word "INYONE" is **1-11-111-1111.**

THE CHARACTERS REVERSED ARE:

E	O	12	21	K	P	2121	1212
F	V	2221	1222	Q	W	1211	1121
G	J	2211	1122	R	U	211	112
H	L	122	221				

THE OPPOSITES ARE:

B	M	2112	1221	C	S	121	212

TO SIGNAL WITH FLAG OR TORCH (See Column 1).

There is but *one* position and *three* motions.

The *first position* is with the flag held vertically in front of the center of the body, butt of staff at height of waist, signalman facing squarely toward the station with which it is desired to communicate.

The *first motion*, or "one," or "1," is a motion of the flag to the right of the sender, and will embrace an arc of 90°, starting with the vertical, and returning to it, and will be made in a plane exactly at right angles to the line connecting the two signal stations.

The *second motion*, or "two," or "2," is a similar motion to the left of the sender.

To make the third motion, "front," or "three," or "3," the flag is waved to the ground directly in front of the sender, and instantly returned to the first position.

End of a word	3
End of a sentence	33
End of a message	333
Repeat last word	121-121-3
Repeat last message	121.121.121.3
Error	12-12-3
"I understand"	22-22 3
Cease signaling	22-22-22-333
Move a little to the right	211.211 3
Move a little to the left	221.221.3

ABBREVIATIONS.

a	after.	h	have.	t	the.	w	word.
b	before.	n	not.	u	you.	wi	with.
c	can.	r	are.	ur	your.	y	why.

x x 3 — "numerals follow," or "numerals end."
sig 3 — signature.

Numbers which occur in the body of a message must be spelled out in full. Numerals may be used in signaling between stations having naval signal books using the Code Calls.

CODE CALLS (See Column 3).

A. S. U. — Action or Battle Signals Use.
I. C. U. — International Code Use.
T. D. U. — Telegraphic Dictionary Use.
G. L. U. — Geographical List Use.
G. S. U. — General Signals Use.
C. A. U. — Cipher "A" Use.
C. B. U. — Cipher "B" Use, etc.
N. L. U. — Navy List Use.
V. N. U. — Vessel's Numbers Use.

TO SEND A MESSAGE.

"To call" a station, signal its initial or "call letter "acknowledged." To "acknowledge," signal "I under followed by its initial or "call letter."

Make a slight pause after each "letter," also afte "front."

FOG SIGNALS (See Column 4).

To apply this code to the "fog whistle" or "fog horn: (1) *toot* (about ½ second) will be "one," or "1." Two (2) *t* quick succession) will be "two," or "2." A blast of abo onds long will be "three," or "3."

The signal of execution for all tactical or drill signals one (1) *long blast*, followed by two (2) *toots* in quick succes

The *ear*, and not the *watch*, is to be relied upon for the *in*

TO SIGNAL WITH FLASH LANTERN (See Colum

Same as in fog signals, substitute "short flash" for " and "long steady flash" for "blast." The elements of should be slightly longer.

To "call" a station, make the initial or "call letter "answered." The station called will "acknowledge" off its flash, and the calling station will proceed with the m

No abbreviations will be used in the body of the messag

All other conventional signals are the same as for flag o

TO SIGNAL BY GUN-FIRES, BELLS, OR GON (See Column 5).

At night, or in fog, mist, or falling snow, sound signals made as follows: The General Signal Book and Geogr List may be used. The numbers will be the numerals Naval Code, one gun or one stroke of bell or gong being two guns or two strokes in rapid succession a "2," an guns or three strokes in rapid succession a "3." The " "Repeat," "Affirmative," "Interrog.," etc., are shown umn 5.

NIGHT SIGNALS.

All night drill signals, and signals involving a change of formation, course, speed, or order, are to be considered as *preparatory*. The signal of execution will be a *rocket* for the Very's System, and the cornet (R R R R) in the Electric Night System.

VERY'S NIGHT SIGNALS.

General Call — Rocket, followed by G.

Message Call — G without the rocket.

The Squadron, Division, Section, or Ship's Call — The "Number" of Squadron, Division, Section, or Ship.

Answering, or I understand — R.

Repeating, or I do not understand — G.

Danger or Distress — R repeated several times in quick succession.

GENERAL INSTRUCTIONS FOR VERY'S CODE.

Squadron, Division, Section, or Ship's Numbers are denoted by being immediately preceded by a rocket. Example: Ajax. Rocket, R R R R.

A message like "Send a boat" will be executed at once, whether a rocket follows or not. If a rocket should be used in this case, it would denote urgency.

All night-signal messages, whatever their nature, require an immediate response. If the message is understood, the immediate response will be R; if not understood, it will be G.

With the Very's Code the General Signal Book is used, as all signals are numerals. The person receiving the message will note the stars as they appear, dividing them into groups of fours without any regard to time intervals, thus ascertaining the signal number.

NOTE. — Through some unforeseen cause a long interval may elapse between two stars of a message. No account must be taken of this as long as it is less than about a minute. Again, a star may be broken by the shock of discharge, and show several stars of the same color in the air. Record but one star. Bracketed stars are always of different colors, and are projected so as to be seen in the air at the same time.

ELECTRIC NIGHT SYSTEM.

In column 2, R stands for red light and W stands for white light. Each character is made in *one* display read from *top to bottom*, and must be repeated by all the vessels to which signals are made. This repeating back takes the place of the *answering pennant.*

The cornet (R R R R) corresponds to the rocket in the Very's. It calls all vessels in sight when displayed preliminary to signaling. In the body of a signal it becomes the numeral "1." Ship's calls (the initial letter of their name usually) are made by turning on and off (i.e. flashing) their call letter. The flagship's call is always "F." The "Letters" Call (R R R W) indicates that the message is to be spelled out. The letters H, R, D, L, S, U, T, A, N, and O are used as Code Calls by pulsating their uppermost light. The Code Calls can be made by making the Code Call (W R R R), then the initial Code letters, I. C. U. or G. L. U., or etc.

Numerals occurring in the body of a letter's message must be spelled out.

HELM AND SPEED SIGNALS (Sound).

Going ahead — "I am directing my course to starboard," one blast.

Going ahead — "I am directing my course to port," two blasts.

Going astern — "I am going full speed astern," three blasts.

"Slowing to avoid danger ahead," "Look out astern," toots for five (5) seconds.

DAY SPEED SIGNALS — CRUISING IN SQUADRON.

Black cone on endless halliards run through block at signal yard arm.

Hoisted at yard arm, *apex up*, indicates that the vessel is going ahead at prescribed speed.

If for any cause a vessel is going ahead slower than the prescribed speed, the cone must be lowered half way down (apex being *up*).

The cone hoisted half way up, with apex *down*, indicates that the engines of the vessel displaying it have been signaled to

back, but that the vessel is not necessarily or actually making appreciable stern-board.

With apex *down*, and cone up at yard arm, signifies that the vessel displaying it has gathered decided stern-board, and is moving astern under the continued operation of her engines.

When the engines are stopped, the cone is lowered out of sight.

NIGHT SPEED SIGNALS—CRUISING IN SQUADRON.

Going ahead at prescribed speed, white light at main truck. Slowing down from prescribed speed, the white light is flashed, if it is electric, otherwise it is lowered half way down. (The electric light is turned off after flashing.) *Stopping* is indicated by turning on a red truck light at main (if electric), and *backing* is indicated by *flashing* it. (The white light is turned off or lowered in *backing* or *stopping*.)

A white oil light is always displayed aft on the taffrail, inclosed in a box so as to show two points on either quarter. A red lantern is kept in a box aft, screened from view. In *stopping*, this red light is displayed *above* the white light. Backing, it is displayed *below* it. This method of signaling is used in vessels not having an electric plant, and in vessels whose electric plant is disabled.

The display of the red light, either aft or at the truck, is a "danger" signal, indicating *stopping* or *backing*, according to circumstances, and supersedes all other signals. It is answered by the vessel next astern displaying a red light to show that she understands.

The Helm and Speed Signals (Sound) given above may be used either by day or night to indicate the purpose in using the helm or engines, in addition to the display of the speed signals.

Ammunition for Hotchkiss Secondary Battery Guns.

			1-Pounder, Light.	1-Pounder, Heavy.	3-Pounder, French.	6-Pounder, U.S.	6-Pounder, or 50 Cals.
Steel shell.	Empty shell	Oz.	17.8	14.1	48.7	89.4	5.59
	Bursting charge	Oz.	0.5	0.5	1.8	4.0	4
	Percussion fuse	Oz.	1.4	1.4	2.3	2.3	2.3
Common shell.	Empty shell	Oz.	13.8	13.5	48.7	90.4	5.65
	Bursting charge	Oz.	0.8	1.1	1.8	2.9	2.9
	Percussion fuse	Oz.	1.4	1.4	2.3	2.3	2.3
Case shot.	Total weight	Oz.	20.0	20.0	52.8	107.3	6.7
	No. of balls		28	28	40	80	80
Empty cartridge case		Oz.	4.8	5	23.7	30	2.31
Total cartridge, steel		Oz.	23.8	25	102.4	154	10.34
Total cartridge, common		Oz.	17.0	25	102.4	154	10.34
Total cartridge, case		Oz.	25.3	28	102.4	159	10.34
Total length of cartridge		In.	6.57	8.81	20.5	18.9	25.87

Driggs-Schroeder Secondary Battery Guns.

	Unit.	1-Pounder. L. P.	1-Pounder. H. P.	3-Pounder.	6-Pounder. Field.	6-Pounder. H. P.	6-Pounder. H. P. Mark II.
Caliber	In.	1.457	1.457	1.85	2.244	2.244	2.244
Diameter at bottom of powder chamber,	In.	1.575	1.61	2.283	2.709	2.709	2.709
External diameter round chamber	In.	3.8	3.8	6.61	7.5	8.3	8.3
Total length	In.	50.9	61.08	87.95	72	107.33	107.33
Length of bore	In.	48.1	58.28	83.25	67.32	100.98	100.98
Length of bore	Cal.	33	40	45	30	45	45
Travel of shell	Cal.	30.7	36.7	37.7	26.7	40.4	38
Number of grooves	. .	12	12	20	24	24	24
Depth of grooves	In.	.0155	.0155	.016	.012	.012	.012
Width of grooves	In.	.322	.322	.23	.2205	.2205	.2205
Length of line of sight	In.	26.4	26.4	30.19	23.6	35.11	38.56
Line of sight from axis of gun. Hor. distance	In.	1.7	1.7	2.36	2.6	2.65	2.65
Line of sight from axis of gun. Vert. distance	In.	2.5	2.5	4.1	3.8	4.74	4.74
Weight of breech block	Lbs.	3.75	3.75	13.5	18	26	26
Weight of gun complete	Lbs.	88	100	500	400	783	910
Weight of powder charge	Lbs.	.17	.31	1.72	1.2	1.87	3.0
Volume of chamber	In.	5.48	8.53	48.53	39.8	54.45	84.3
Muzzle velocity	F. S.	1460	1800	2050	1500	1870	2200
	F. T.	16.7	25.4	95	93.6	148.1	205

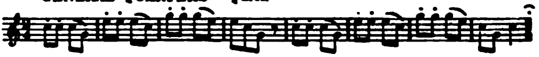
Driggs–Schroeder Ammunition.

		Unit.	1-Pounder.		3-Pounder.	6-Pounder.		
			L. P.	H. P.		Field.	H. P.	H. P. Mark II.
Steel Shell.	Radius of ogival	Cal.	2.25	2.25	2.1	. .	2.75	2.75
	Total length	In.	3.66	3.66	6.46	. .	8.58	8.58
	Weight of shell	Lbs.	.97	.97	3.03	. .	5.76	5.76
	Weight of burster	Lbs.	.023	.023	.10	. .	.22	.22
	Weight of fuse	Lbs.	.133	.133	.133	. .	.133	.133
	Weight, total	Lbs.	1.13	1.13	3.26	. .	6.11	6.11
	Ratio of weight to cube of caliber of gun,	. .	.365	.365	.515	.541	.541	.541
Common Shell.	Radius of ogival	Cal.	2.25	2.25	2.29	2.46	2.46	2.46
	Total length	In.	3.9	3.9	6.89	8.39	8.39	8.39
	Weight of shell	Lbs.	.93	.93	2.99	5.43	5.43	5.43
	Weight of burster	Lbs.	.041	.041	.137	.22	.22	.22
	Weight of fuse	Lbs.	.133	.133	.133	.133	.133	.133
	Weight, total	Lbs.	1.10	1.10	3.26	5.78	5.78	5.78
Fixed Ammunition.	Total length (Steel Shell)	In.	6.57	8.22	20.11	. .	19.14	. .
	Total length (Common Shell)	In.	6.57	8.22	20.55	16.19	18.88	. .
	Weight of empty case	Oz.	2.99	5.5	21	29.5	31.5	. .
	Weight of charge	Oz.	2.82	4.9	27.53	19.2	31.5	48.
	Weight of felt wad	Oz.	.11	.11	.21	.25	.25	.25
	Total weight (Steel Shell)	Lbs.	1.5	1.78	6.29	. .	10.06	. .
	Total weight (Common Shell)	Lbs.	1.37	1.75	6.29	8.84	9.73	. .

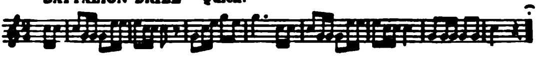
BUGLE CALLS.

QUARTERS FOR INSPECTION. Mod.

GENERAL QUARTERS Quick

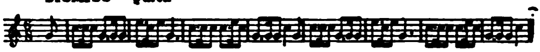


BATTALION DRILL Quick.



SECURE Quick.

DISMISS Quick



SILENCE Slow.

TRUMPETERS CALL. Quick.

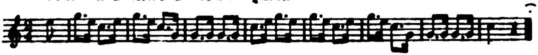
CLEAN AND BRIGHT WORK Mod

PUT UP CLEANING GEAR Mod

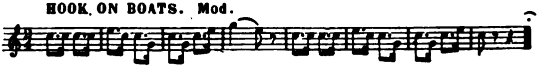
***SICK CALL.* Quick**

MUSTER BOATS' CREWS. Quick.

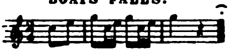
MAN AND ARM BOATS. Quick.



HOOK ON BOATS. Mod.



BOATS' FALLS.



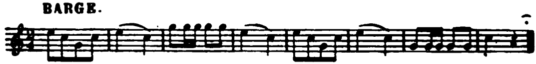
BOATS' CALLS.

LAUNCHES.

CUTTERS.

WHALE BOAT.

BARGE.



GIG.

DINGHY.

If there be more than one boat of a kind, its number is indicated
number of G's, preceding and following the main call.

Weight of Gun.	Chamber Pressure.	Muzzle Velocity. (Service.)	REMAINING VELOCITY AT 1000 yds.	1500 yds.	2000 yds.	2500 yds.	Muzzle Energy.	Thickness of Steel which Shell will Perforate at Muzzle.
	Tons	Feet-Seconds.					Foot Tons.	In.
102	15	2000	1651	1501	1364	1246	915	7.18
103	"	2000	"	"	"	"	"	7.18
103	"	2000	1697	1563	1439	1323	1660	8.07
140	"	2250	1847	1673	1516	1374	1754	9.00
108	"	2000	1735	1616	1505	1402	2773	10.27

3 2044 019 090 3

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